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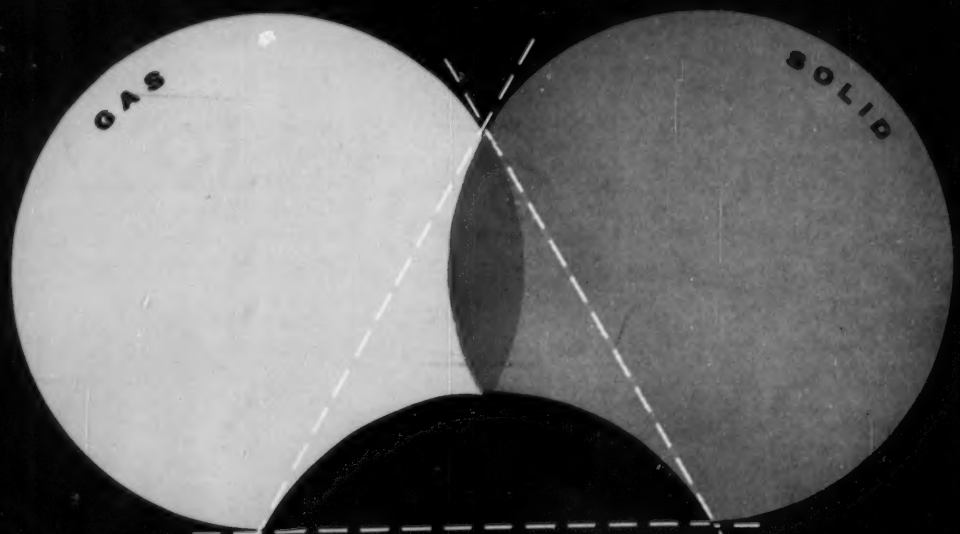
Chemical Engineering

AUGUST 1956



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A 32-page report that will modernize your thinking about the most important group of chemical engineering operations

"No other group could have done a better job than GIRDLER"

reports Texas Eastman Company about Girdler's Engineering Service

IN 1954, Girdler engineered and procured the equipment for the Longview, Texas, polyethylene plant of the Texas Eastman Company, a division of Eastman Kodak.

After the plant was in operation, Texas Eastman's engineering management reported: "The polyethylene plant has operated extremely well, thanks in a large part to the very fine job everyone at Girdler did for us. Time and again, we can see where the thought that went into the layout and piping up of equipment has paid off in a very large way. We know that no other group could have done a better job, and it is highly unlikely that anyone would have done as well as Girdler."

And Now . . . Girdler Selected Again

Texas Eastman is now expanding this Longview plant. And the above comments point up why Girdler has been selected for engineering and procurement of equipment and materials for the new facilities as for the original plant. Texas Eastman—like so many leading companies in the chemical, petroleum, plastic materials, food and fertilizer fields—has found that Girdler's broad experience results in outstanding process performance for them.

When you plan plant expansion or modernization, take advantage of Girdler's *complete design-engineering-construction* service. You can get all the facts by contacting our nearest office.

the **GIRDLER** Company

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AUGUST 1956

JOHN R. CALLAHAM, Editor

More on New Products?

Two of our departments that command high reader respect are Chemicals & Raw Materials and Process Equipment News. Together they come to about 15 pages per issue.

Like most magazines, CE has tough standards on what can qualify for these product departments—so tough that only 20-25% of the items we receive make the grade.

Readers tell us they appreciate this critical screening by our own engineer-editors. It saves them time, highspots the facts on the most important new products each month.

Manufacturers benefit, too. For although it's tougher for their products to make the grade, the payoff for those that do measure up is enhanced reader interest, respect and response.

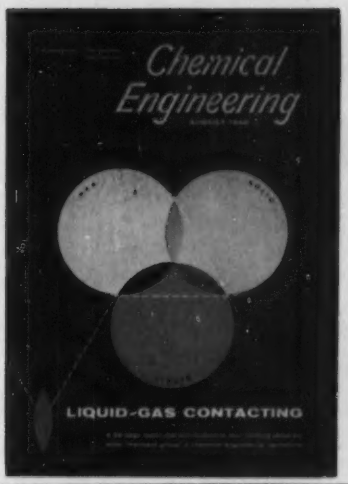
We could easily run 100 or more pages a month solely on new products and the application, problem-solution and case-history type of stories based on products already on the market.

But to do this would sacrifice much of the basic material on engineering know-how, economics and process advances that the vast majority of our readers prefer.

Besides, readers tell us that many of these product "success" stories are, unfortunately, neither new nor particularly newsworthy to experienced engineers and production men.

Such are the reasons why we've kept CE's new product departments down to hard-core, factual items carefully screened for timeliness and value to chemical engineers.

Research shows that over 93% of you agree with us in this decision.



GUIDED TOUR

A critical spotlight on today's liquid-gas contacting operations

Here's a practical evaluation of current liquid-gas contacting practices. It will bring you up-to-date and stimulate you to take a fresh look at the whole picture. It stresses how you should consider all alternates to be sure you pick the equipment best suited to your needs. (p. 175)

To exploit your own talents

You'll find here a stimulating proposal for relieving the engineering shortage. A prominent consultant urges increased personal efficiency. "How to" advice emphasized by six horrible examples. (p. 207)

What linear programming can do

As a new technique, this segment of operations research will aid management and

Please turn page

Chemical Engineering

AUGUST 1956

GUIDED TOUR

engineers in solving problems. It helps organize facts, analyze alternatives, plan courses and select programs. (p. 211)

How linear programming works

Hitting the optimum is the aim of this modern approach. Solution of our hypothetical case study will tip you off on where you might use the method for tackling some of your own problems. (p. 215)

Answers to a pilot-plant question

Organic heat transfer fluids fill most requirements for general pilot-plant use. Here are common-sense answers to questions you face in selecting the one best suited to your own needs. (p. 217)

Want a career in patent law?

Now open for inspection—the field of patent law. What the job opportunities are, what they require, training and how to get it and how long it takes, what the rewards can be. (p. 238)

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To keep pace with the chemical, petrochemical and chemical process industries, more engineers subscribe to Chemical Engineering than to any other publication. Total net paid circulation of this issue:

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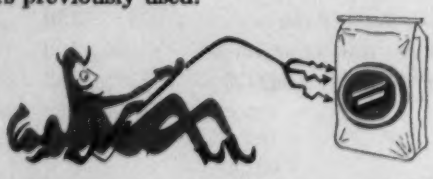
How four tough, diverse chemical packaging jobs were solved with Bemis Bags...

caustic materials

problem: Develop a shipping container with special properties to resist the corrosive action of the contents... and to cost less than the rigid containers previously used.



solution: A special multiwall paper bag, made by Bemis... a sewn valve type with a polyethylene-coated inner sheet... that cost only about one-third as much per hundredweight (including filling and closing labor) as the containers previously used. Further savings were made in storage space of both empty and filled containers and in lower shipping costs due to reduced tare weight.

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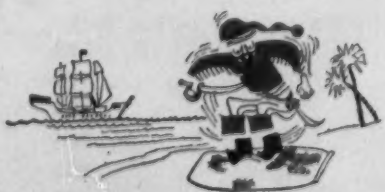
powdered aluminum

problem: The product must be protected against moisture and the shipping container must also be tough enough to stand up in export shipment.



solution: Bemis Waterproof (laminated-textile) Bags, which gave the necessary moisture protection and the required durability (they're the toughest shipping bags made). Furthermore, they save the shipper a lot of money, as the bags cost about 40 cents each, as compared with $1.25 for drums of equal capacity. There is also a substantial saving in empty container storage space.

polystyrene crystals

problem: Develop a shipping container that will (a) keep the polystyrene crystals entirely free from foreign matter, even down to lint particles, (b) withstand the rigors of export shipment, involving multiple handling, exposure, etc., and (c) cost less than the double-packaging (with overslips) previously used.

solution: A special type of laminated-textile valve bag developed by Bemis. The bag is constructed of tough burlap laminated between two types of special paper . . . providing ample strength, resistance to abrasion and freedom from lint. An ingenious method of sewing prevents burlap lint from getting into the polystyrene. Substantial savings are made on every bag shipped, not only on bag cost but also on labor.

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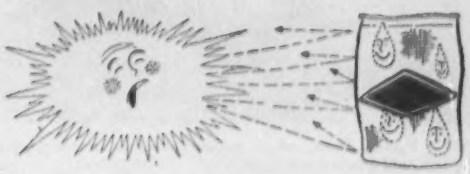
resin beads

problem: Find a lower cost, easier handling shipping container for ion exchange resin beads in which the moisture content must be maintained at its original approximate 45%. The material was previously shipped in fiber drums.



solution: A Bemis Waterproof (laminated textile) Bag, with a loose poly liner. After being filled, the liner is tie-closed and the burlap bag is closed by sewing. Advantages—Necessary moisture content is retained. Shipping weight is substantially reduced. Bags are more easily handled and require less unloading time. Drum disposal problem is eliminated. There is a storage space saving of 30% on filled bags and an even greater saving in empty container storage space.

Whether your shipping container problems are similar to any of these . . . or far removed from them . . . it's likely that Bemis can help you reach a money-saving solution. Write, wire or phone us. You will soon know whether we can help you.

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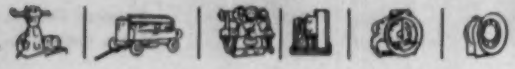
for VANEAXIAL FANS • COMPRESSORS • OXYGEN GENERATORS VACUUM PUMPS AND BOOSTERS



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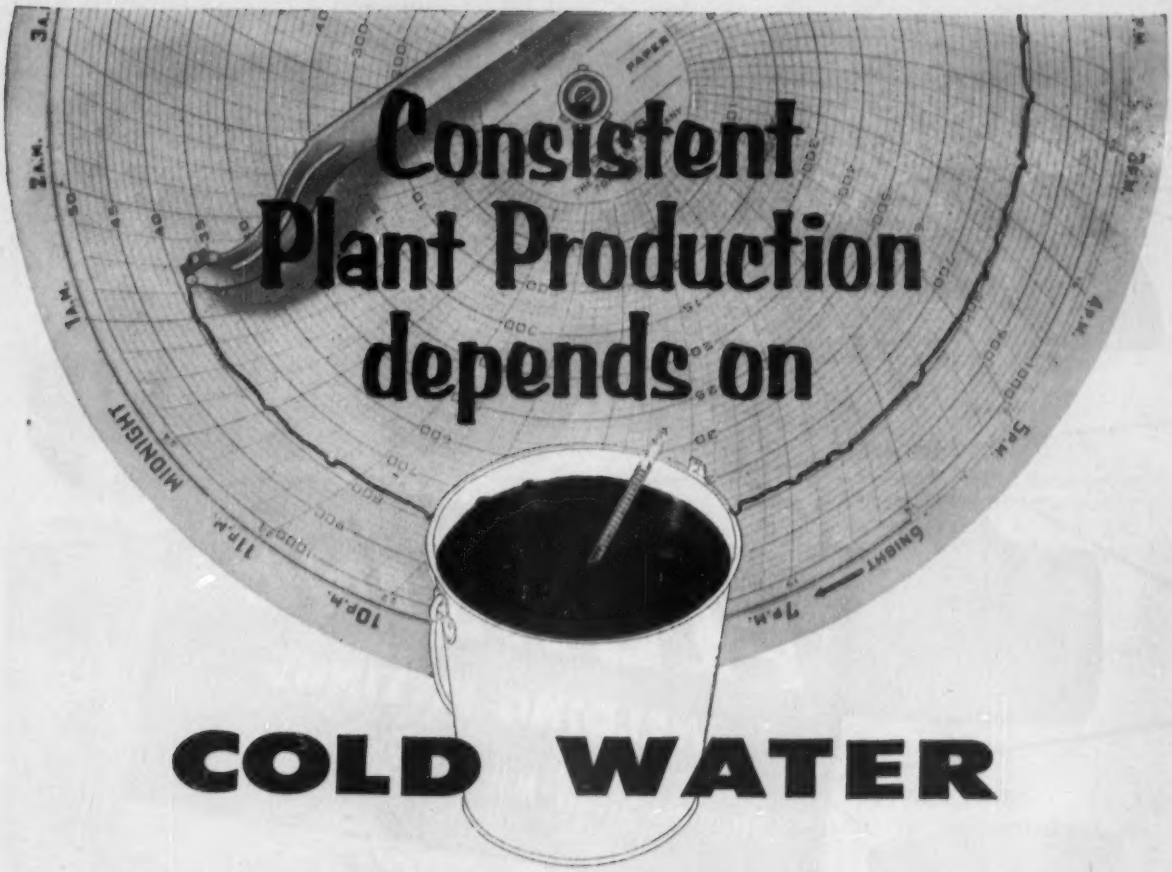
SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885



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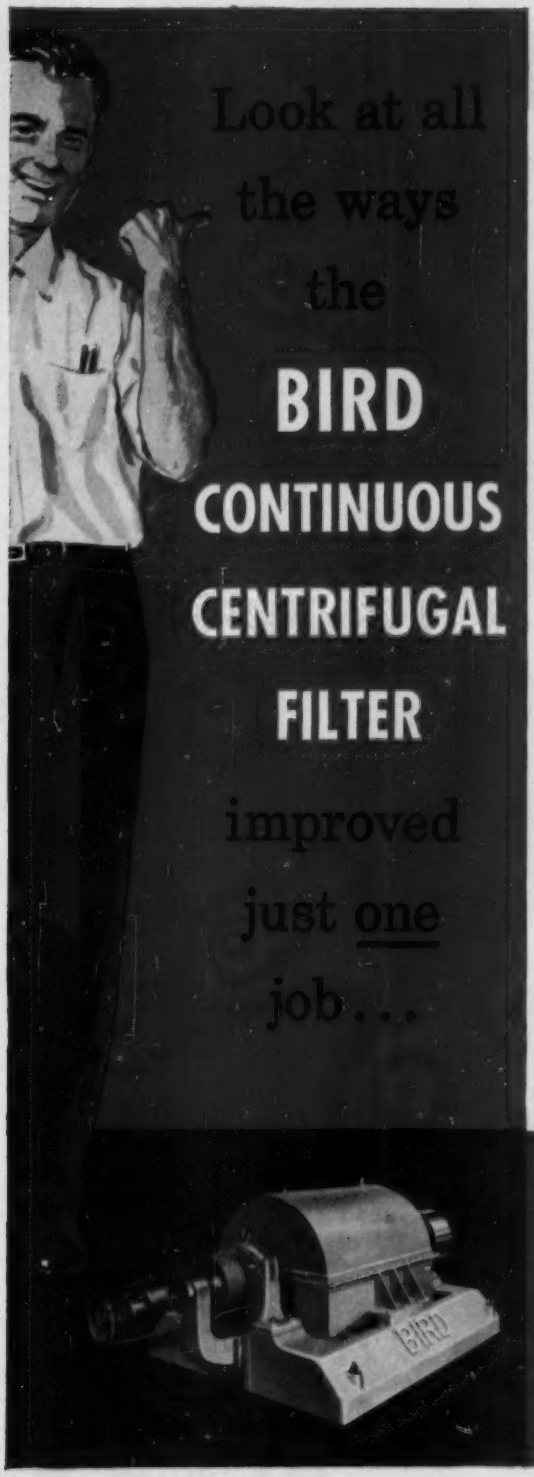

Look at all the ways the BIRD CONTINUOUS CENTRIFUGAL FILTER improved just one job...

A Bird Continuous Centrifugal Filter replaced a continuous filter of another type on a pigment dewatering job. Here's what happened:

FROM	TO
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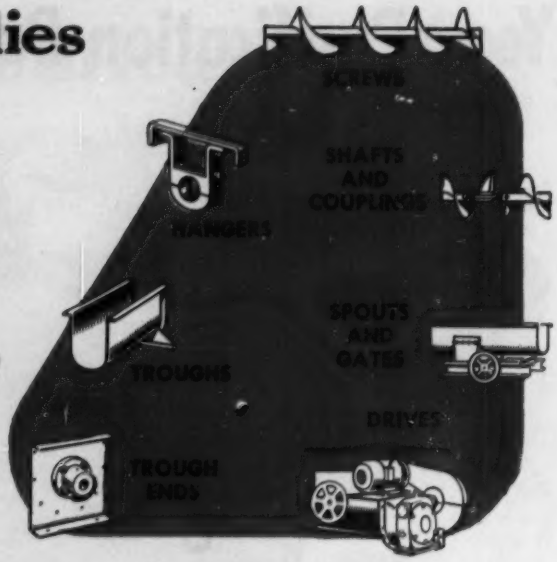

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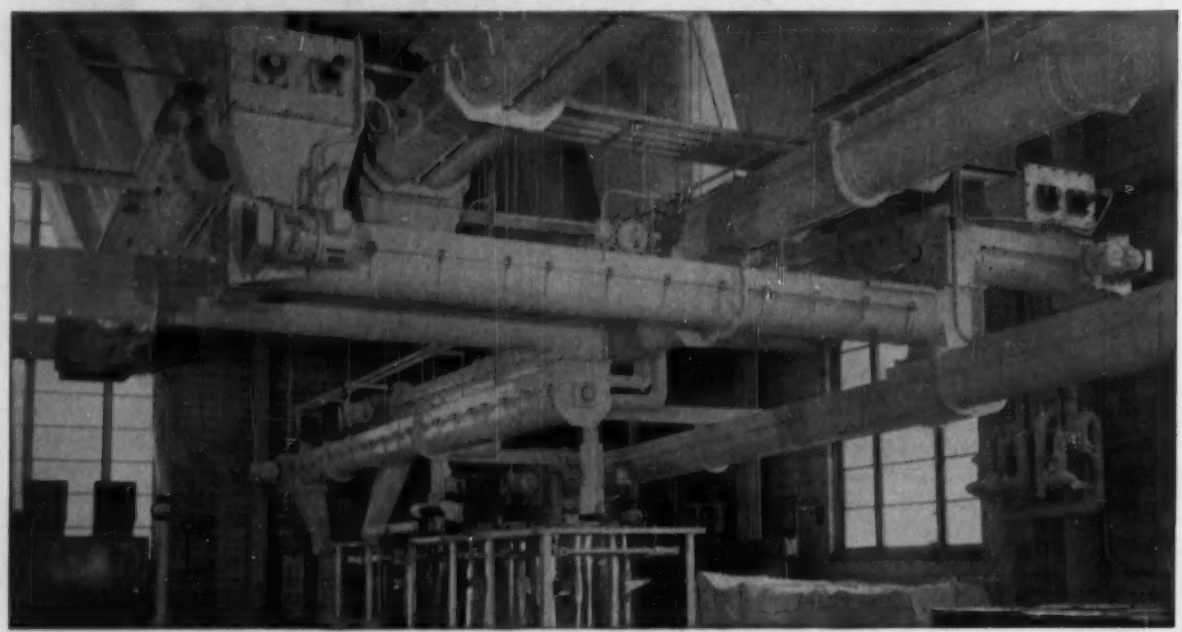

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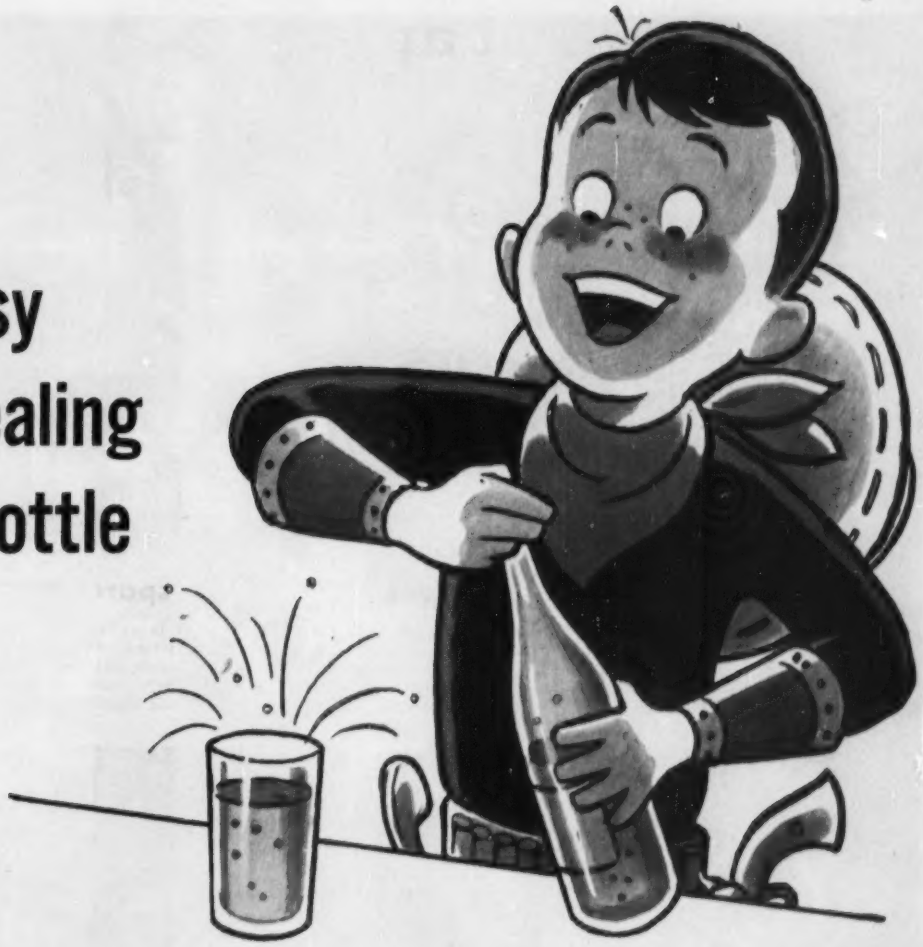

Hackney removable head stainless steel drums protect shipments... open easily... close tightly

Here's the air-tight, liquid-tight shipping container that provides instant access to congealed or solidified contents.

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to complete your PVC piping system

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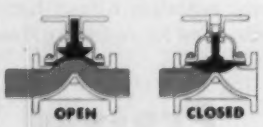
PVC, of course, has exceptional chemical resistance to aging or deterioration of any kind, and can be successfully used with most chemicals. It has high strength, light weight, and can be easily joined by threading or by solvent welding.

In addition to the new Grinnell valve with PVC body and diaphragm, Grinnell offers PVC pipe in schedules 40, 80, 120; and Grinnell PVC Fittings (screwed or socket ends). Write for further information.

Important features of the Grinnell-Saunders Diaphragm Valve:

- Diaphragm absolutely isolates working parts from fluid in the line.
- Diaphragm lifts high for full, streamline flow in either direction.
- Diaphragm effects positive, leak-tight closure.
- Diaphragm easily replaced without removing valve body from the line.



GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

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ANALOGUE COMPUTING SERVICE

STAFFED BY
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Dian provides solutions quickly and economically. We are prepared to study your problems and to furnish time and cost estimates.

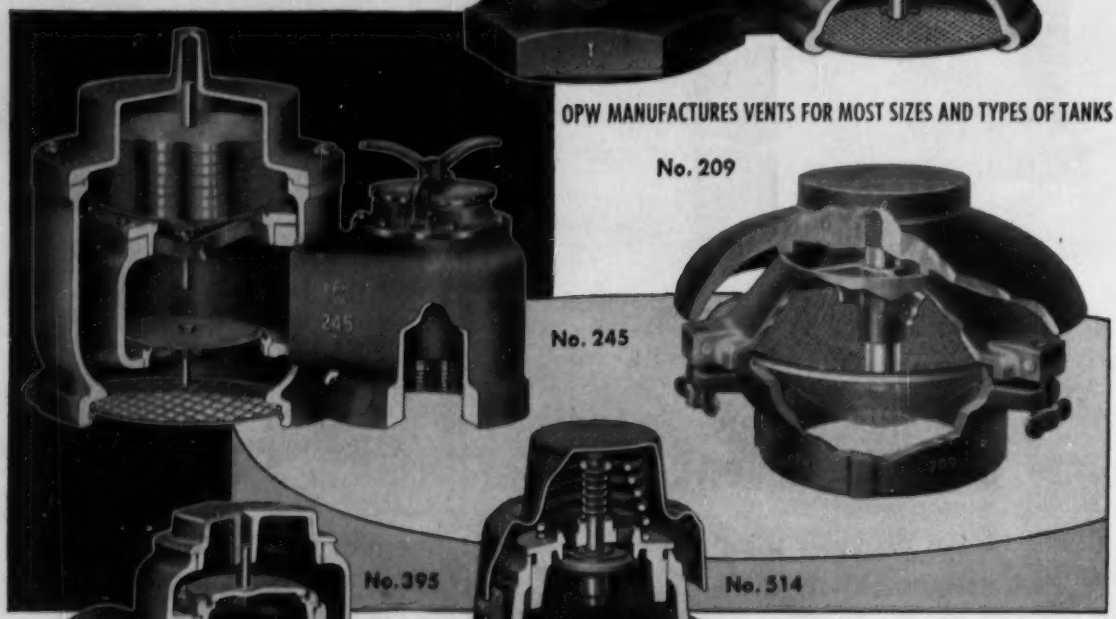
DIAN LABORATORIES, INC.

Prevent costly vapor loss with pressurized

OPW tank vents

There's a vapor saving OPW Tank Vent for every purpose. Precision machined, product engineered for lifetime use, they are your INVESTMENT against vapor loss due to product expansion and temperature variation. Weighted to specifications, OPW Tank Vents trap and hold vapors and release only at set pressures, insuring maximum protection and dollar dividends. Double mesh screen readily accessible for inspection maintains bulk storage safety.

OPW MANUFACTURES VENTS FOR MOST SIZES AND TYPES OF TANKS



- SMALL HOME STORAGE TANKS
- FARM SKID TANKS
- UNDERGROUND STORAGE TANKS
- ABOVE GROUND STORAGE TANKS

Send for the OPW Tank Venting and Emergency Relief Recommendation Chart!

JORDAN CORPORATION
INDUSTRIAL SALES DIVISION OF OPW CORPORATION

6013 WIEHE ROAD • CINCINNATI 13, OHIO
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B.F.Goodrich

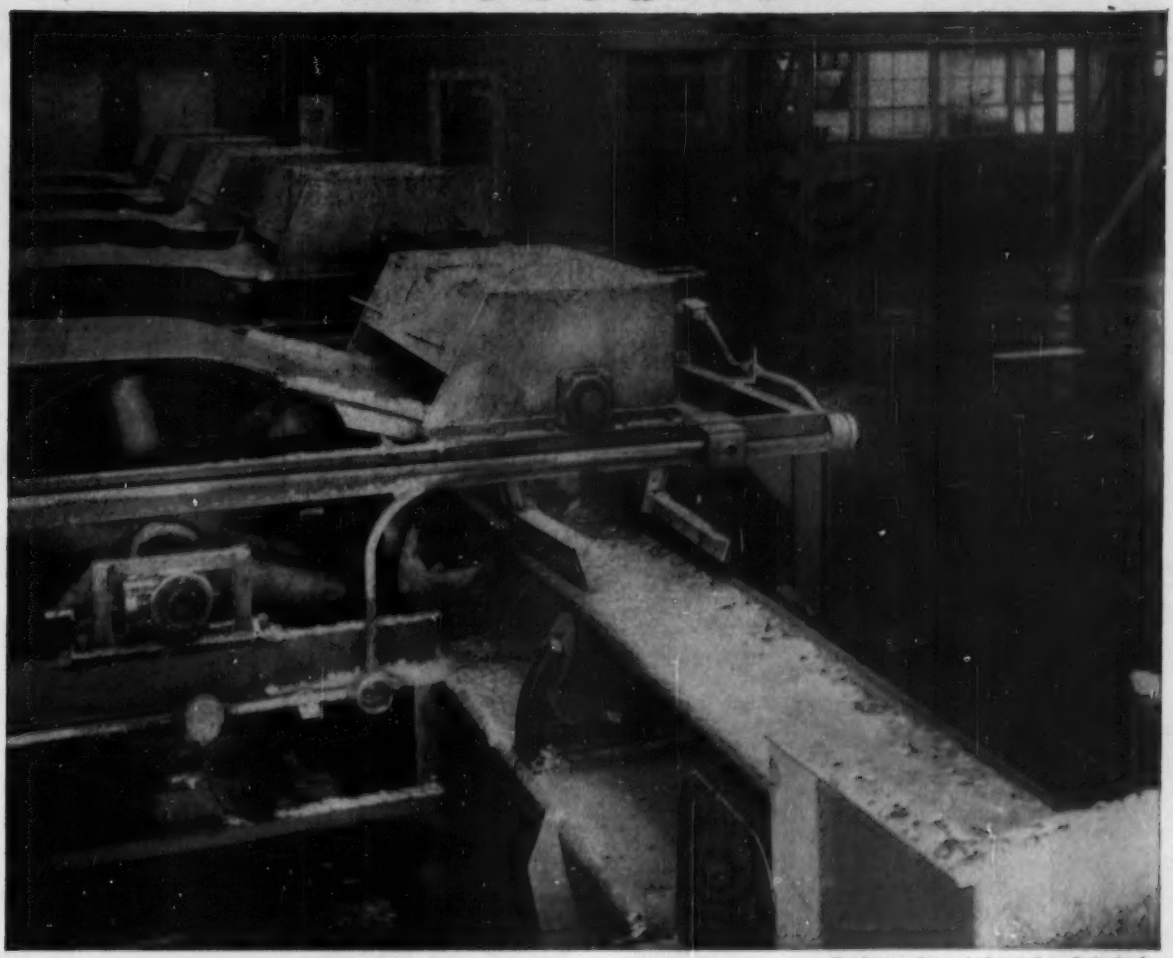


Photo courtesy Commercial Solvents Corp., Sterlington, La.

That white stuff makes the tall corn grow taller

A typical example of B. F. Goodrich improvement in rubber

THE corn on many a farm will grow taller, faster this summer because of the white flakes you see in the picture. It's a powerful fertilizer, called ammonium nitrate.

Moving rubber belts carry it to the crusher. But it's acid and very hot. It baked even specially-made belts hard, made them crack and break in 3 to 6 months.

B. F. Goodrich engineers suggested they try a new, improved B. F. Goodrich hot-material belt. It's made with a special rubber that stays soft and pliable at temperatures that cause other belts to harden and crack.

After thorough tests of this and other types of belting, B. F. Goodrich Solarflex belts were installed. They have already lasted 4 to 6 times longer, have needed absolutely no attention, and still look good. In fact, the maintenance superintendent reports that with Solarflex, belting is now the least of his worries as far as plant maintenance is concerned.

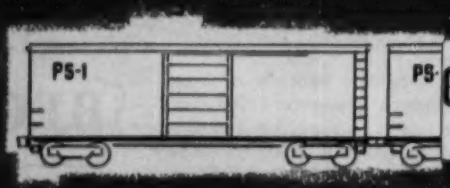
This is only one example of how B. F. Goodrich conveyor belts save money for users because they're engineered for special jobs. Belts are made of many kinds of cords and fabrics, many different kinds of rubber compounds. There's a B. F. Goodrich belt for almost every problem. Call your B. F. Goodrich distributor for more information about any kind of belting, hose or other rubber products. Or write *B. F. Goodrich Industrial Products Co., Dept. M-704, Akron 18, Ohio.*

B.F.Goodrich

INDUSTRIAL PRODUCTS

the PS-2
COVERED HOPPER

WEATHERTIGHT HATCH
AND HATCH COVER



BUILT TO SERVE BEST ON THE
GREAT AMERICAN RAILWAY
System
BY PULLMAN-STANDARD

keeps bulk shipments CLEAN and DRY

faster loading and unloading, too, mean important time and money savings for shippers and consignees

Built by Pullman-Standard, leader in the carbuilding field, the PS-2 Covered Hopper Car is standardized for maximum service to shipper, consignee and railroad.

For any dry lading capable of being shipped in bulk the PS-2 offers assurance that dirt and weather will be excluded. Patented Pullman-Standard circular hatches are designed so that driven rain cannot build up against the coaming and seep up and under the hatch cover. The lip of the coaming is rolled downward as an added weather safeguard. The hatch cover makes firm and smooth sealing contact with the entire circumference of the coaming rim. Special, easy-to-operate latch assemblies hold the covers tightly closed. The properly located circular hatches permit rapid loading and unloading with hose or wand, while the Pullman-Standard design of hoppers, hopper chutes and hopper doors allows fast unloading directly into take-away devices. Hopper doors operate easily, but close securely and positively, permitting no loss through leakage.

The PS-2 Covered Hopper Car is built with worker safety in mind. Hatch cover latch assemblies are located well away from the roof edge. Hatch covers hinge so that opening and closing are parallel to the length of the car: the cover of the open hatch lies on the roof, out of the working area. Workmen perform most operations from the security of the nonslip running board and it is unnecessary for men to walk on or over opened hatch covers or approach the edge of the roof.

The PS-2 is now in service in two sizes: two hopper, 2003 cu. ft. with 8 loading hatches and 4 unloading doors, and three hopper, 2893 cu. ft. with 10 loading hatches and 6 unloading doors. In either size, every PS-2 is built with the precision craftsmanship that has helped Pullman-Standard become the leader in the carbuilding field. And every PS-2 is thoroughly water tested to make certain that it is completely leak proof.

Standardized freight cars, the PS-1 Box Car, PS-2 Covered Hopper, PS-3 Open Hopper and PS-4 all-purpose Flat Car, are built only by Pullman-Standard. And standardized freight cars are designed, tested and mass produced with the precisely engineered craftsmanship that has made them outstanding in economy, dependability and performance. Shipper, consignee and railroad all benefit through specifying Pullman-Standard Standardized Freight Cars.

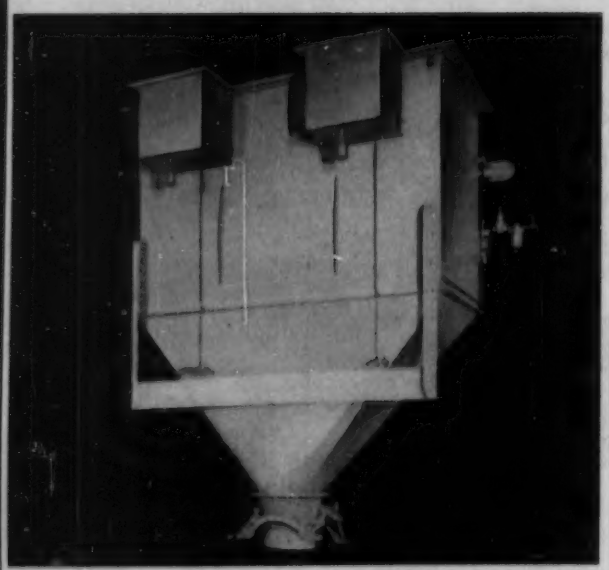
More than 9500 PS-2 Covered Hopper Cars have been put into service or ordered by 46 service and shipper-conscious railroads. To learn how the PS-2 could handle your bulk shipments as it does hundreds of materials, write Pullman-Standard.

PULLMAN-STANDARD

CAR MANUFACTURING COMPANY
SUBSIDIARY OF PULLMAN INCORPORATED
79 EAST ADAMS STREET, CHICAGO 3, ILLINOIS
BIRMINGHAM, PITTSBURGH, NEW YORK, SAN FRANCISCO, WASHINGTON

The Man from

opens new doors to stop



DOOR ONE—HE BRINGS YOU A NEW HIGH SPEED, PRECISION SCALE

Most companies give away extra ounces to guard against an underweight package . . . to avoid alienating a customer. If you give away just 2 extra ounces of a 10 cents a pound product in every 50 lb. bag . . . it really starts adding up.

On 95% of all bags packed with free-flowing material, the new 135-AS Model D Scale weighs the bag charge accurately within plus or minus two ounces. And a single bucket scale can handle up to 12 fifty pound bags per minute or 10 one hundred pound bags.

HERE'S WHAT A TYPICAL USER TELLS US:

The Hopewell, Virginia, plant of the Nitrogen Division of Allied Chemical & Dye Corporation has planned its entire production line around the 135-AS Model D Duplex Scale. They use it for open-mouth packing of sodium nitrate and ammonium nitrate-limestone. Periodic weight checks show that the scale maintains *exact* weight on 92.5% of all bags packed under high-speed operating conditions —and that in all cases weight is held within 4 ounces on 100 lb. bags.

St. Regis

product "give-away"

Behind the Man from St. Regis stand experts in every field of packaging, ready to serve you.

DOOR TWO—YOU OPEN THIS DOOR FOR MORE INFORMATION

Multiwall Packaging Division
St. Regis Paper Company, Dept. CE-856
150 East 42nd Street
New York 17, N. Y.

Please send me details about the new 135-AS Model D Scale.

Name_____ **Title**_____

Firm_____

Address_____

City_____ **State**_____

ST. REGIS PAPER COMPANY

Life ...on the Chemical Newsfront

BETTER MILK-CONTAINER STOCK is among many improved paper products made possible by CYFOR® Fortified Rosin Size. To fortify rosin size, which ordinarily has one carboxyl group, small quantities of organic acids are added, thereby increasing the carboxyl groups to three. The rosin becomes more reactive to cellulose, increasing the sizing effect which prevents passage of fluid through paper. This helps keep wax coatings on the surface where they are most effective, and helps prevent leakage should the coating crack. CYFOR Size makes it possible to get higher sizing effects than ordinary size, or attain equal specifications using less size. It is increasingly used by paper mills to improve paper quality and reduce costs. **(Industrial Chemicals Division, Dept. B)**

NURSES GRADUATING THIS YEAR will be even more radiant in uniforms made of fabrics treated with CALCOFLUOR* White ST. This new textile brightener, applied during fabric processing, absorbs ultraviolet radiation, transforms it and reflects it as visible light in the blue range of the spectrum. Counteracting yellowness in the material, the blue radiation makes the fabric whiter and brighter. CALCOFLUOR White ST works equally well in white-background prints and stripes, or drapery florals, in printed dress fabrics and in woven or knit goods. It is used primarily on cottons and is applied with standard equipment. Washing with commercial soaps or detergents containing CALCOFLUOR White restores the whitening effect. **(Organic Chemicals Division)**

*Trademark

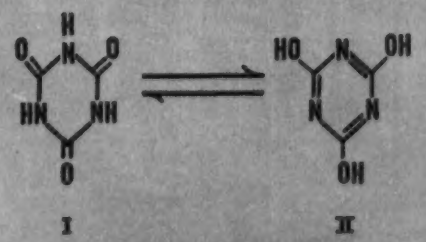
LAMINAC® RESIN TRAYS OUTLAST METAL for drying dye intermediates, pigments and other corrosive chemicals in nine-month evaluation just completed at two Cyanamid plants. Fabricated of glass fiber and LAMINAC Polyester Resin 4109 by Molded Fiberglass Tray Company, some 61,000 drier trays have given highly satisfactory service. Light and easy to handle, they have high impact and dent resistance, and with no coating to chip or flake, eliminate danger of contaminating materials being dried. In several industries, molded LAMINAC trays are replacing other materials because they are non-corrosive, uniform, smooth, rugged, low in cost and easy to maintain. **(Plastics and Resins Division)**

NEW PIGMENTS developed by Cyanamid for use in exterior finishes must first pass rigorous tests on accelerated weathering equipment in the Pigment Development and Application Laboratory. Test-fence and field-exposure tests follow for final proving. These tests ensure that Cyanamid's pigments meet the critical, highly demanding levels of color stability required in exterior finishes. Protective coatings formulated with such pigments as Phthalocyanine Blue and Green, Chrome Yellow, Orange and Green, Iron Blue, Toluidine, Permaton, and UNITANE® Titanium Dioxide, among others, in this way meet conditions of exposure as taxing as any nature can provide in actual use. **(Pigments Division)**

IMPROVED LUGGAGE and other leather products will go along on vacation this year with many of the natural advantages of leather enhanced and controlled by chemistry. Among chemicals supplied to tanners by Cyanamid, TANAK® MRX Tanning Agent proves especially valuable in white or colored leathers. Applied at the tanning drum, TANAK MRX permeates the stock and polymerizes, filling the body of the leather. Leather comes out softer and more supple, with a tighter break, thicker grain and better temper. Other Cyanamid chemicals for tanners include bating and dehairing agents, dyes, pigments and extracts. **(Organic Chemicals Division)**

NEW PRODUCT DATA

CYANURIC ACID

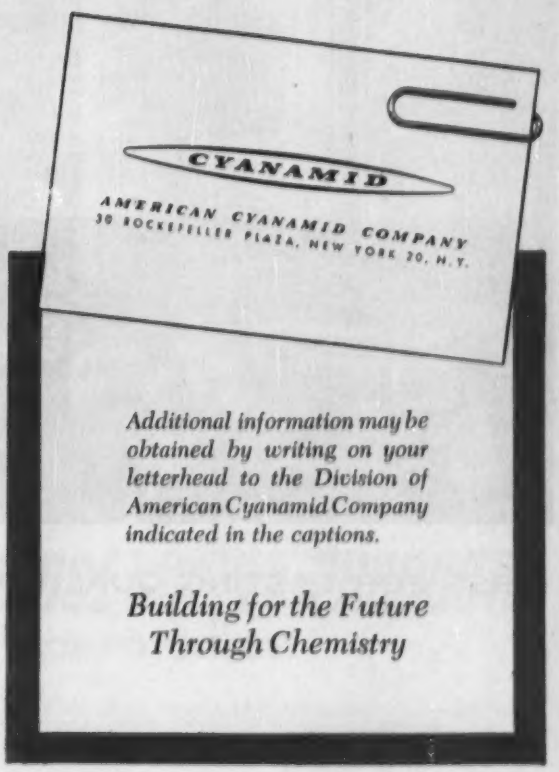


I II

PHYSICAL PROPERTIES

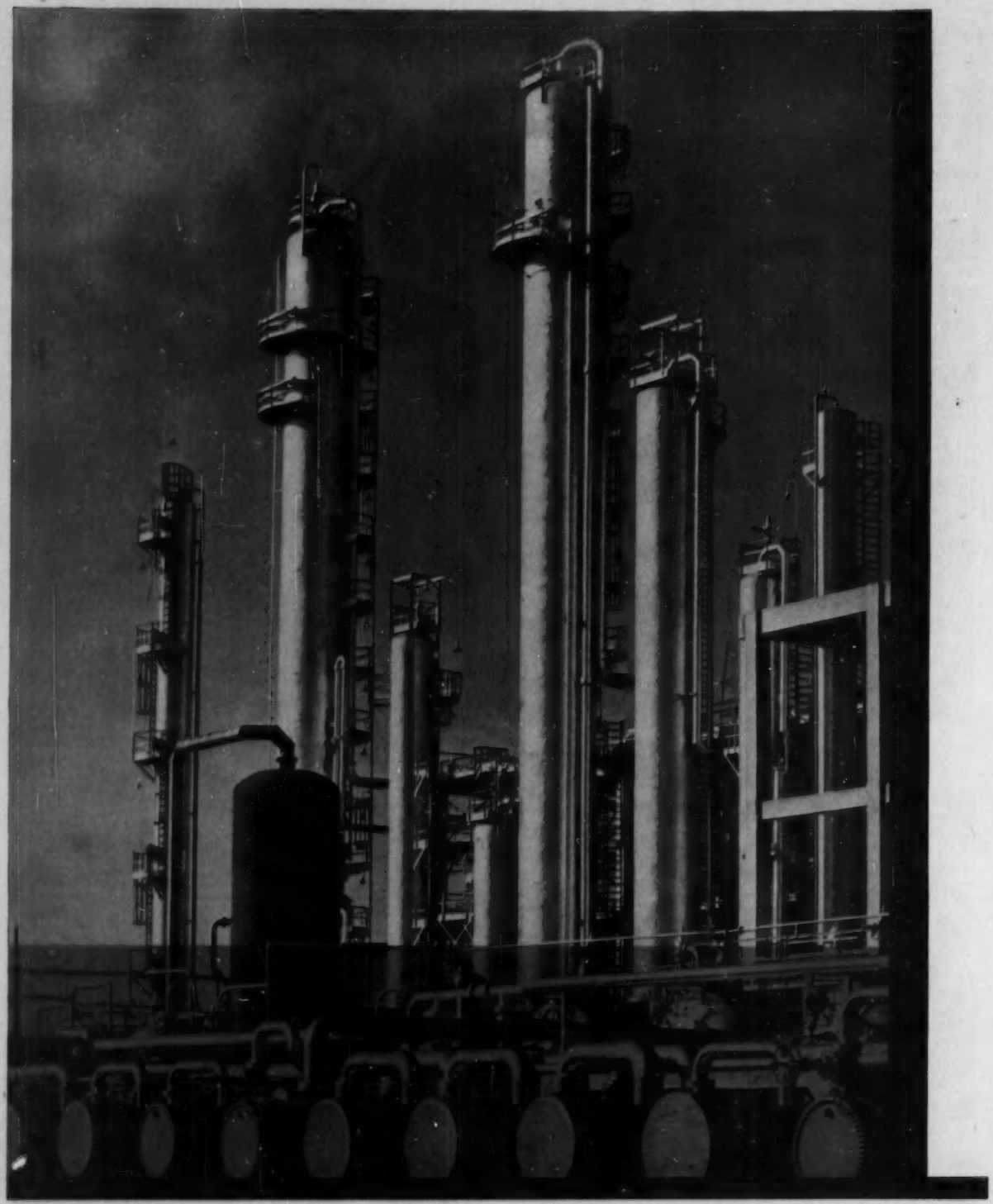
Appearance	White solid	Solubility	Water at 20° C: 2.5 g./l. Moderately soluble in hot water. Soluble in concentrated sulfuric acid and alkali. Insoluble in most organic solvents.
Molecular Weight (Theory)	129.08		
Melting Point	Infusible		
Dissociation Constants, K_a at 25° C			
First	6.31×10^{-8}		
Second	7.94×10^{-13}		

CYANURIC ACID, an interesting s-triazine derivative, is now being offered by Cyanamid in pilot-plant quantities. Both as a solid and in aqueous solution, cyanuric acid exists principally in the lactam or iso-form (I). It yields salts with most inorganic cations and with some organic bases and many alkaloids. Highly colored salts are formed with metallic ions in the presence of ammonia. Reactions with ammonia, phosphorus pentachloride, methyl iodide, diazomethane and sodium hypochlorite have been reported. Cyanuric acid may be used to prepare trichloroisocyanuric acid, a solid bleaching agent. It has a herbicidal action that may be selective, and should also be interesting in pharmaceuticals, microanalysis, resin formation and dyestuffs. **(New Product Development, Department B)**

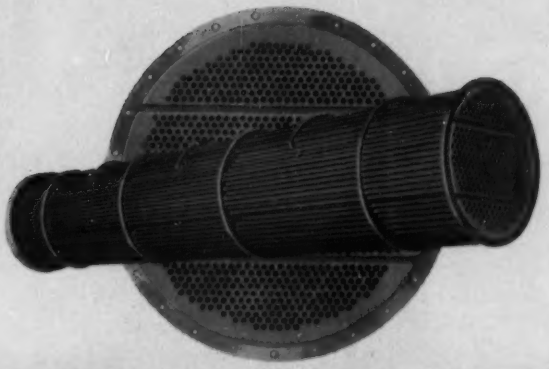


Additional information may be obtained by writing on your letterhead to the Division of American Cyanamid Company indicated in the captions.

Building for the Future Through Chemistry



FIRST FOR LASTING QUALITY—FROM MINE TO MARKET!



For dependable "on-stream" performance . . .
retube your exchangers with

PHELPS DODGE HEAT EXCHANGER TUBES!

Wide selection of copper-base alloys for every type of application—including bi-metal combinations.

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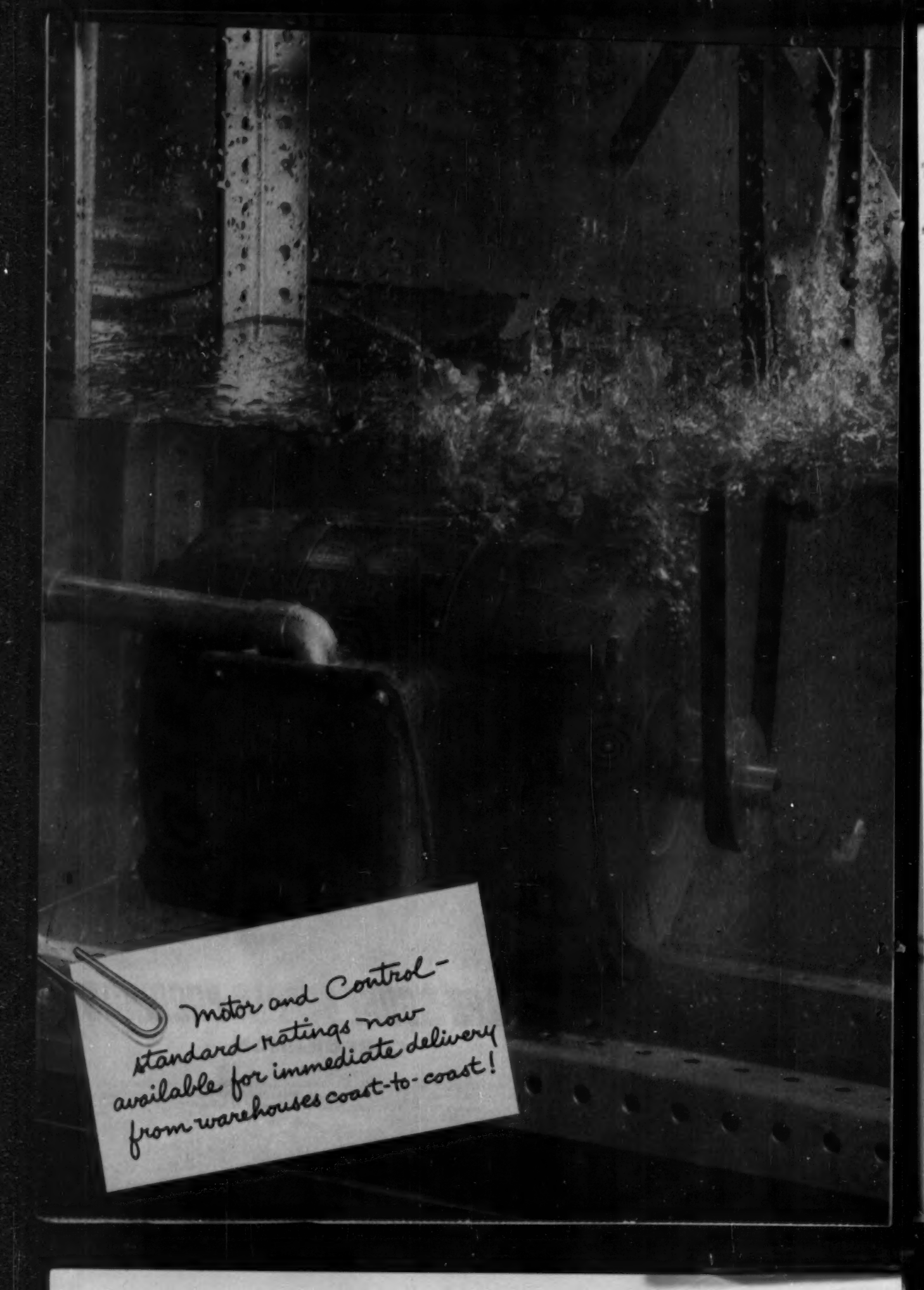

Motor and Control—
standard ratings now
available for immediate delivery
from warehouses coast-to-coast!

TOMORROW:

A Standard Motor That Can Live With Water?

The New Life-Line A Is Another Step Closer

Today's standard motors cannot long endure the water conditions shown here. But Westinghouse is working toward a standard motor that can "live" with water like this tomorrow.

Meanwhile improved frame design, insulation and bearing protection give the Life-Line® "A" more protection than ever before. It can withstand more water and other contamination than any other motor you can buy. It's industry's closest approach to a standard motor that can operate with or within water—in any amount.

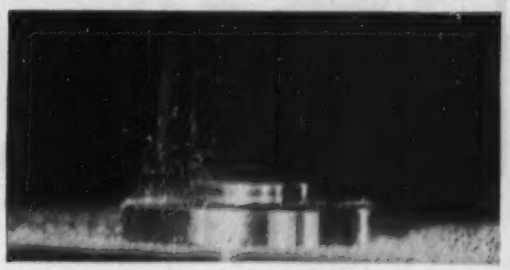
Your Westinghouse sales engineer can show you many additional reasons why the Life-Line "A" is industry's most advanced and preferred motor. Call him today.

J-21924-A

New cast-iron frames and brackets utilize the finest grained castings with uniformly thick-walled sections precisely fitted and sealed—another reason why the Life-Line "A" is so preferred.

WATCH WESTINGHOUSE!

COVER THE PRESIDENTIAL CAMPAIGN ON CBS TV AND RADIO!



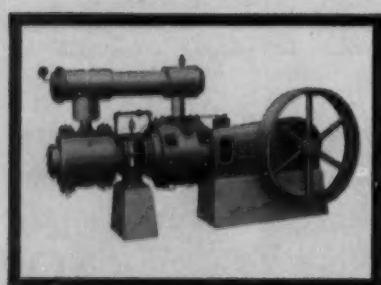
Two outer seals of new 4-way sealed bearing act as flingers and literally throw off damaging contaminations. Inner seals, attached to outer bearing race, are stationary and form a positive labyrinth.

Class T
compressors

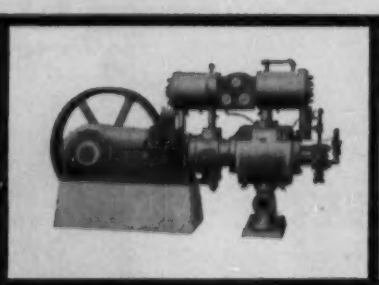
for the plant whose process requirements range from

Vacuum - 7500 psia
up to 150 hp

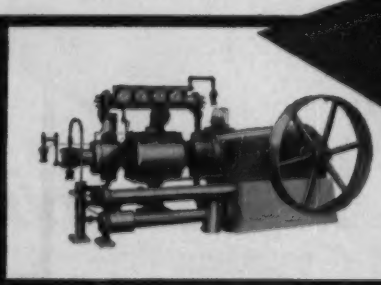
The Class T Compressor is but one of a complete line of CP compressors for process work.
Other types available in sizes to 5,000 HP for pressures to 15,000 psig, with motor, steam or belt drive.



Two-Stage Class TCB-2 Compressor for pressures up to 500 lbs.

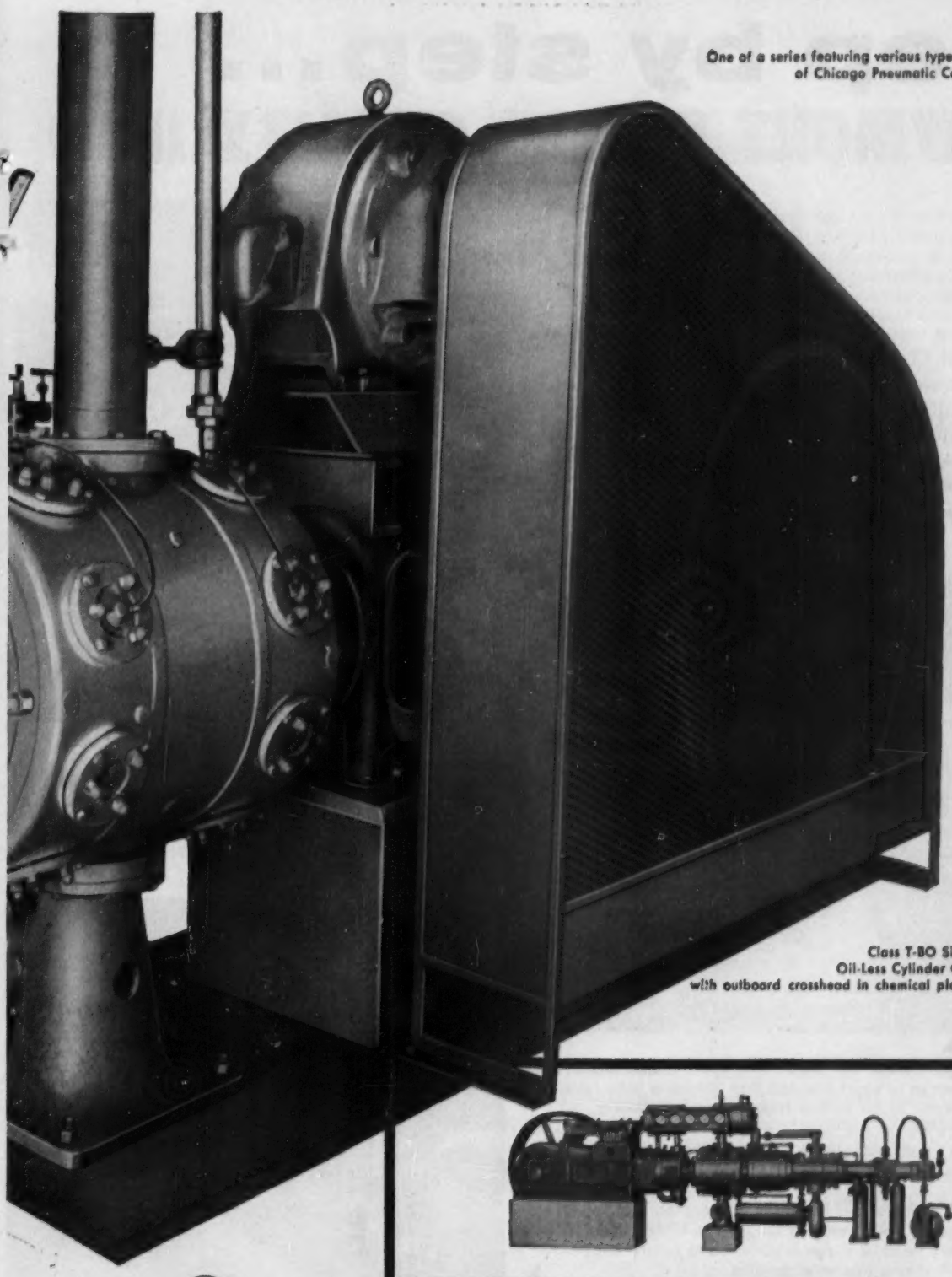


Typical Three-Stage Class T Compressor for pressures up to 2,500 lbs.

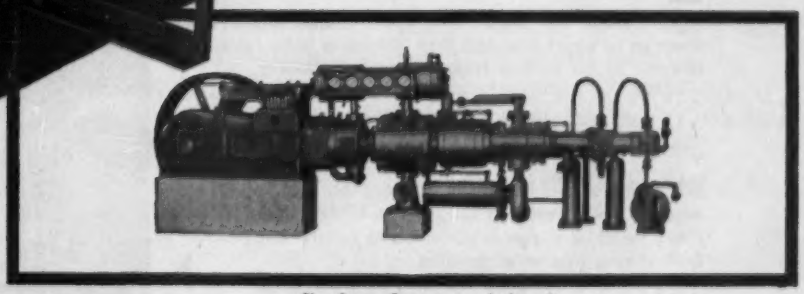


TCB-4 Four-Stage, straight-line Compressor suitable or 6000 lbs. discharge pressure.

One of a series featuring various types and sizes of Chicago Pneumatic Compressors.



Class T-80 Single-Stage Oil-Less Cylinder Compressor with outboard crosshead in chemical plant service.



Five-Stage Compressor designed for 7500 lbs. service.

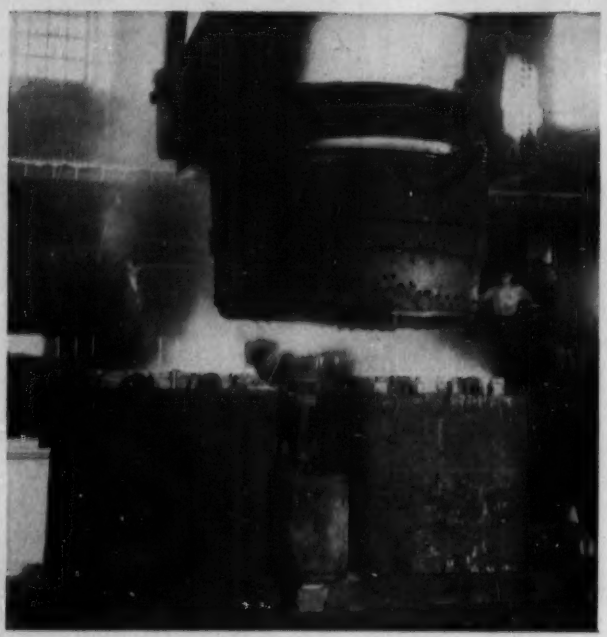
Chicago Pneumatic

8 East 44th Street, New York 17, N. Y.

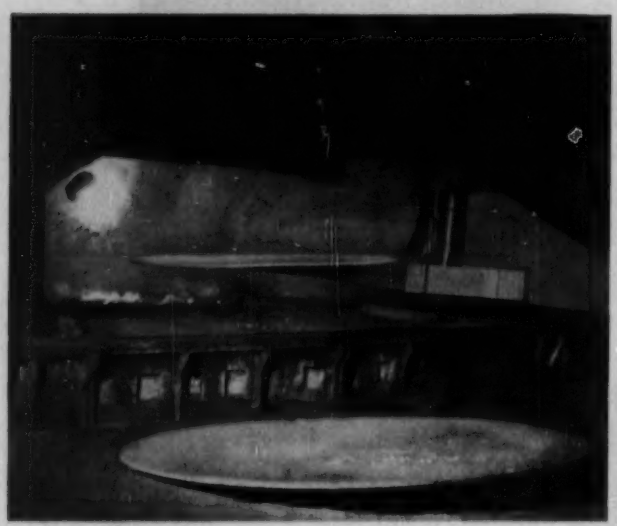
AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC TOOLS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS

step by step...
CLAYMONT BUILDS QUALITY INTO

Our customers have been telling us for years that Claymont Flanged and Dished Heads successfully meet every requirement for top quality. The reason behind such high performance is that we build quality into every head throughout every stage of production—from raw materials to finished product. Here's how:



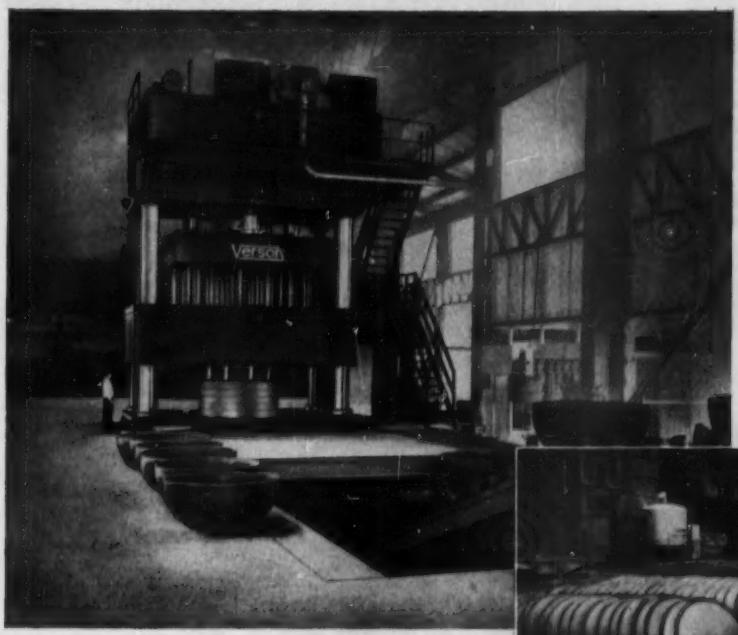
Because we make our own steel, we can carefully control its chemical and physical properties. Here, steel is being "bottom-poured". This means that the ingot mold is filled from the bottom, thus assuring a more uniform steel.



After rolling the ingots into plate, steel circles are sheared to exact size and then heated in huge furnaces like this to the proper temperature for spinning.

This highly skilled craftsman is operating a big spinning machine which produces heads up to 19 feet in diameter. Every head he makes is subjected to careful inspections, both during and after forming.

ITS FLANGED AND DISHED HEADS



Claymont's head pressing facilities include this new 3000-ton giant, capable of hot or cold forming large diameter heads up to 10 feet. With this modern equipment, Claymont can press steel heads that will meet your most exacting specifications.

Stock Heads—You can be sure of quick delivery when you order from Claymont. That's because CF&I maintains large stocks of popular size heads, as well as many types of fittings for tanks and pressure vessels, at these warehouses: Los Angeles, Tulsa, Houston, New Orleans, Chicago, Buffalo and Claymont, Delaware.

and don't forget these other important members of the Claymont family...

- **Alloy Steel Plates**
- **Stainless-Clad Plates**
- **CF&I Lectro-Clad Nickel Plated Steel Plates**
- **Fabricated Steel Parts**
- **Large Diameter Welded Steel Pipe**

Like our heads, all Claymont products have quality built in—by just such painstaking controls and tests during every step of manufacture. For complete information on any Claymont product, contact our nearest sales office or write direct to Wickwire Spencer Steel Division, The Colorado Fuel and Iron Corporation, P.O. Box 1951, Wilmington, Delaware.

4223

CF&I

Claymont Steel Products

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There's **MORE** Cooling Surface in these deep-ribbed **MOTORS**

No Day is FRYDAY with these Allis-Chalmers MOTORS

● Frying of insulation is impossible under normal conditions with the extra-large cooling surface of Allis-Chalmers rib-type TEFC motors. The result—you expect and get longer motor life.

The engineered partner of A-C motors is Allis-Chalmers control.

Get Complete Information

As a new machinery component or as replacement, specify Allis-Chalmers. Discuss your particular application with your nearby A-C distributor, A-C district office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

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U.S.I. CHEMICAL NEWS

July-Aug. ★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★ 1956

U.S.I. TO PRODUCE ZIRCONIUM SPONGE; A.E.C. TO TAKE MILLION LBS. PER YEAR

Sodium Reduction Process to Be Used for Zirconium Manufacture—Yields Purer Product at Much Lower Cost

A 1,500,000 pound-per-year plant for the manufacture of reactor-grade zirconium sponge is being constructed by U.S.I. at Ashtabula, Ohio, site of the company's sodium and chlorine production facilities. Both of these raw materials will be used in the process when the installation goes onstream in mid-1957.

One million pounds per year for a five year period have already been committed to the Atomic Energy Commission according to a contract signed in May, 1956. This was the largest single contract awarded by the A.E.C. in its zirconium procurement program.

Essential in Atom Program

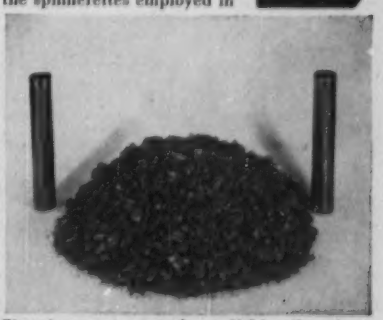
Reactor-grade zirconium is essential as structural material for atomic reactors and for cladding uranium, because of its low nuclear cross-section. This ability to let neutrons pass through increases the fuel efficiency of the reactor. Zirconium also has extremely high corrosion and heat resistance vital in atomic energy applications. Hafnium, always found in association with zirconium in the natural state, must be removed in an extra refining step in the manufacture of reactor-grade material, because of its neutron-trapping qualities, although the hafnium does not interfere with zirconium's corrosion resistance.

Important to Chemical Industry

The commercial grade, with 1-3% hafnium content, is expected to be used extensively by the chemical process industries. It has excellent resistance to acids, alkalis, corrosion and heat, combined with strength, ductility, light weight and good machining properties. It is hoped that U.S.I.'s new process can eventually bring the price of commercial grade zirconium sponge down to about $3.50 per pound, which is expected to result in finished fabricated zirconium parts priced at about $15 per pound. At this price it will be competitive with other high-quality materials of construction.

Zirconium has been used for many years to fabricate the spinnerettes employed in

MORE



Zirconium sponge made at U.S.I. pilot plant, flanked by 2 zirconium test rods.

U.S.I. Semi-Works Metals Plant at Ashtabula Is Under Construction

A half million pound-per-year semi-commercial metals plant is being built by U.S.I. at Ashtabula, adjacent to the site of the projected full-scale zirconium unit, and will be completed by September of this year. It will be used for production of zirconium sponge during construction of the larger installation.

Titanium, hafnium, thorium, beryllium and other metals can probably be made in this plant by the same basic U.S.I. process. The new plant will serve as proving ground for production of these metals when, and if, full-scale production is planned.

Recovery Process Developed

A U.S.I. process for recovering reactor-grade zirconium from hafnium-free scrap will undergo large-scale trial runs for the first time at the new unit. Already successful in the laboratory, this recovery process is expected to convert zirconium scrap into sponge on a toll arrangement for about half the cost of virgin sponge. This development is an important one, since only 30% of all zirconium purchased for fabrication is converted into the final structures or parts. Losses during metallurgical and production steps account for the other 70%.

Minimum Standards Being Set for Plastic Pipe

The National Sanitation Foundation has recently announced the establishment of minimum standards for plastic pipe used to carry drinking water. With the cooperation of the Society of the Plastics Industry, an identification program has been set up whereby participating companies use an NSF seal on their pipes and fittings when they meet standards. Manufacturers of the plastic raw materials must also have an NSF OK, and U.S.I.'s PETROTHENE® polyethylene resins have already received this approval.

This move is a step toward standardization of plastic pipe for all purposes. Polytheylene pipe is being used more and more, particularly in the chemical process industries, in applications where the conditions require that the best grade of pipe must be used. Purchasers should be sure they are getting pipe made of 100% virgin material, which will withstand the conditions of use.

U.S.I. can supply on request the names of pipe producers who maintain high quality standards in the manufacture of polyethylene pipe.

Nitrofurans Used as Chemotherapeutic Agents

U.S.I. Diethyl Carbonate Used in Synthesis

Another group of compounds has joined the sulfa drugs and the antibiotics in the fight against infection. This is the nitrofuran group of products, derived from furfural which has had a nitro-group added in the number five position on the ring, and which has been further modified by chemical reaction.

These products have the rare property of remaining effective against bacteria and fungi where resistant strains have been built up against the sulfas and antibiotics. Thus the medical man has a reserve weapon to draw upon when and if other agents begin to lose their effectiveness.

Hundreds of nitrofuran derivatives have been synthesized since 1944, and of these, five have proven effective enough for development into commercially usable antimicrobials:

nitrofurazone for controlling infected wounds, burns, ulcers and other skin lesions; infections of the eye, ear, nose and other mucous membranes; bladder infections; and diseases of cattle and poultry.

nitrofurantoin for treating bacterial infections of the urinary tract.

nitrofurfuryl methyl ether for fungi, spores and bacteria which attack the body.

furazolidone for treating some types of vaginal infections, and diseases in poultry. The U.S.I. product diethyl carbonate is used in the synthesis of this material.

A fifth derivative is now almost ready for marketing.

The work of synthesizing and testing new derivatives continues, but investigators are no longer proceeding haphazardly. Years of experiment have shown researchers how various nitrofurans interfere with the multiplication of bacteria in the body, and how these nitrofurans are dispositioned by the body. This information permits the synthesis of derivatives specially designed for specific body infections. As a matter of fact, nitrofurantoin, specific against urinary tract infections, was created in this way.

Other members of this group show anesthetic properties. Some are antihistaminic, and some affect certain types of cancer cells. So far, all exhibit a minimum toxic effect.

ADVERTISEMENT—*This entire page is a paid advertisement* *Prepared by U. S. Industrial Chemicals Co.*

July-Aug. ★ **U.S.I. CHEMICAL NEWS** ★ 1956

CONTINUED

Zirconium

viscose rayon manufacture because of its resistance to the alkaline xanthate solution on one side and sulfuric acid on the other. Some other applications include:

- "Getters" in radio tubes. A "getter" is a small piece of metal enclosed in a vacuum tube which combines with any gases remaining to take them out of circulation. Zirconium has high affinity for gases, extends the life and efficiency of tubes.
- Desulfurizing, deoxidizing and anti-aging agent for steel. This use is also based on the metal's affinity for gases.
- Alloy for magnesium and gold.
- Powder metallurgy.

Sodium Process Employed

The new plant will be the first to make zirconium sponge employing semi-continuous production techniques developed by U.S.I. research men in the company's own laboratories. These techniques involve the use of sodium as the reducing agent for zirconium tetrachloride, and yield a zirconium sponge of greater purity as a result.

Zirconium sources are abundant, and the metal has been known and used for many years in its impure form. But production of a pure, ductile metal has presented many technical difficulties. Only in recent years, first with magnesium and now with U.S.I.'s sodium reduction process, have the problems of refining the metal been licked.

New Process Lowers Costs

The method, which can probably also be applied to other metals such as titanium, thorium, beryllium and hafnium, has the advantage over conventional processes of a lower initial investment cost. It is expected to bring the market price of reactor-grade zirconium sponge from the new plant down to less than half of the current price of about $15.00 per pound and to have the same effect on the price of the commercial grade. U.S.I. feels that the lower price plus greater availability will increase applications for the metal substantially. Therefore, the forthcoming plant has been designed for easy and rapid expansion.

Hansa Yellow G Pigment Now in Flushed Form

Produced From Acetoacetanilide

A flushed Hansa Yellow G pigment in paste form is being offered to the protective coatings industry for the first time, for use in finishes where high brilliance, good lightfastness and resistance to alkalis are desired.

This organic azo pigment is produced by coupling *m*-nitro-*p*-toluidine and acetoacetanilide. It is transferred from the water to the oil phase through pigment flushing in a medium-short glycerol phthalate soya-modified alkyd resin, and reduced with mineral spirits.

Improved Method Found For Administering Urethan In Treatment of Leukemia

A new method of administering urethan (ethyl carbamate) has substantially reduced undesirable side effects which previously limited urethan's use in treating several types of leukemia.

Urethan administered rectally by means of suppositories was found to give the same therapeutic response as that obtained by oral and intravenous treatment. Such adverse after-effects as anorexia, vomiting, nausea and diarrhea were eliminated in most cases.

Electromet Titanium Plant Now Operating At Ashtabula, Ohio

The largest titanium plant in the world, built by the Electromet Division of Union Carbide and Carbon Corporation at Ashtabula, Ohio, went on stream in April 1956.

Metallic sodium acts as the reducing agent for titanium tetrachloride in the process, and is supplied from the U.S.I. sodium plant nearby.

TECHNICAL DEVELOPMENTS

Chemical resistance of polyethylenes, both conventional and low-pressure, and polyvinyl chlorides to about 400 reagents is shown in chart now being offered by plastics processor. **No. 1160**

A new liquid rubber corrosion-resistant coating can be brushed or sprayed onto all types of surfaces. Said to adhere well, shows excellent toughness, flexibility and abrasion resistance. Claimed to be waterproof, to protect against oil, chemicals, fungi, sunlight. **No. 1161**

A pepper-like bite in foods, lozenges, toothpastes and mouth washes can be provided synthetically by beta-cinnamylidene acetoyl piperidide at 1% of the concentration required for natural pepper. May aid carbohydrate digestion. **No. 1162**

Nine new adhesives for modern plastic packages have been developed by one company, both for forming the packages themselves and for labeling. These liquids are custom-made to bond to particular plastics in particular applications. **No. 1163**

Manual on electrically-conductive coatings is available which covers their use in research, development and design in fields such an automation, aircraft, electronics and geology. **No. 1164**

A new pigment for plastics, rubber and printing inks is reputed to have excellent permanence and resistance to heat discoloration. It is a brilliant maroon, non-bleeding, easily dispersed organic pigment. **No. 1165**

Plastic fittings of advanced design for polyethylene pipe are claimed to eliminate leakage problems by featuring secondary serrations beneath the clamp compression area to assure "bite" with the pipe. A hex hub for wrench tightening prevents damage to fitting. **No. 1166**

A new hand cleaner has been designed to remove oil, dirt, tar, pitch, dye, ink, paint or just plain heavy grime rapidly and thoroughly, according to producer. Claimed to give no skin reactions, leaves hands soft. **No. 1167**

The first dermatological cream containing prednisolone, a highly potent anti-inflammatory steroid, is now on the market. Claimed to relieve itching and pain of many allergies and eczemas, shows no systemic absorption. **No. 1168**

New dust mask to protect workers against non-toxic dusts is said to be light, comfortable, easy to breathe through. Polyethylene frames give strength and flexibility. Latex filter protects against particles down to one micron. **No. 1169**

PRODUCTS OF U.S.I.

INORGANIC CHEMICALS:

Sodium, Metallic: cast solid in tank cars, steel drums, pails; bricks in barrels, pails.
Chlorine: liquid, in tank cars.
Caustic Soda: 50% liquid, in tank cars.
Sodium Peroxide: dust-free granules, in drums.
Sulfuric Acid: all strengths, 60° Baumé to 40% Oleum. Also Electrolytic grade to Federal specifications. Tank cars or tank wagons.
Ammonia: Anhydrous, commercial and refrigeration. Tank cars or tank wagons. Also Nitrogen Fertilizer Solutions.

OTHER PRODUCTS:

Alcohols: Ethyl (pure and all denatured formulas), Normal Butyl, Amyl, Fusel Oil; Proprietary Denatured Alcohol Solvents SOLOX®, FILMEX®, ANSOL® M, ANSOL® PR.

PETROTHENE® Polyethylene Resins.

Esters, Ethers and Ketones: Normal Butyl Acetate, Dibutyl Phthalate, Diethyl Carbonate, Diethyl Oxalate, Ethyl Acetate, Ethyl Ether, Acetone.

Intermediates and Fine Chemicals: Acetoacetarylides, Ethyl Acetoacetate, Ethyl Benzoylacetate, Ethyl Chloroformate, Ethylene, Ethyl Sodium Oxalacetate, Sodium Ethylate solution, Urethan USP (Ethyl Carbamate).

Animal Feed Products: Calcium Pantothenate, Choline Chloride Products, Curbay B-G® 80, Special Liquid Curbay®, DL-Methionine, Niacin USP, Riboflavin Concentrates, Vitamin B_{12} and Antibiotic Feed Supplements, Vecetone® 40, Vitamin A, D_3 and K_3 products.

Pharmaceutical Products: DL-Methionine, N-Acetyl-DL-Methionine, Riboflavin USP, Urethan USP, Intermediates.

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Division of National Distillers Products Corporation
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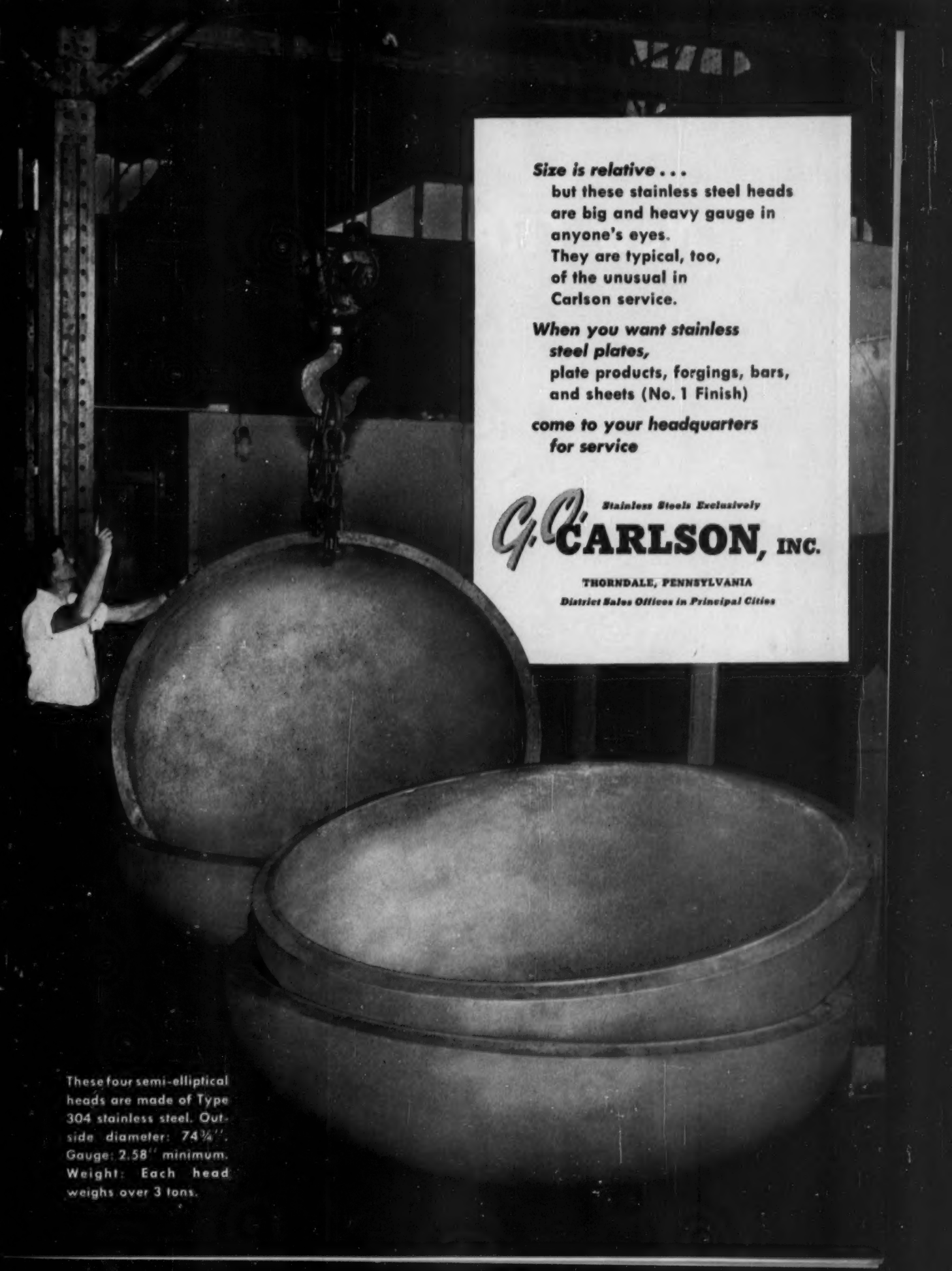


Size is relative . . .
but these stainless steel heads are big and heavy gauge in anyone's eyes. They are typical, too, of the unusual in Carlson service.

When you want stainless steel plates,
plate products, forgings, bars, and sheets (No. 1 Finish)

come to your headquarters for service

Stainless Steels Exclusively

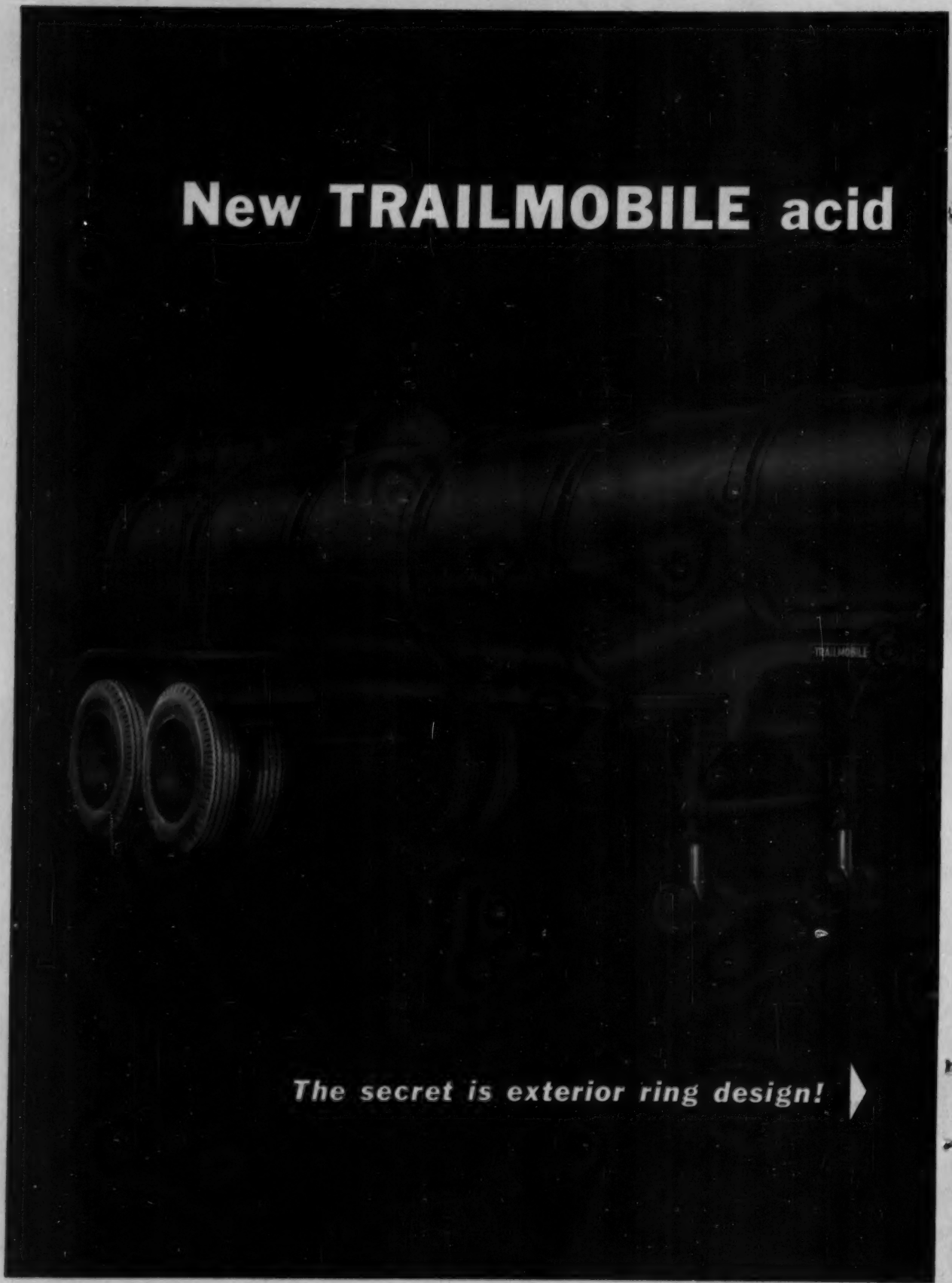
G. O. CARLSON, INC.

THORNDALE, PENNSYLVANIA

District Sales Offices in Principal Cities

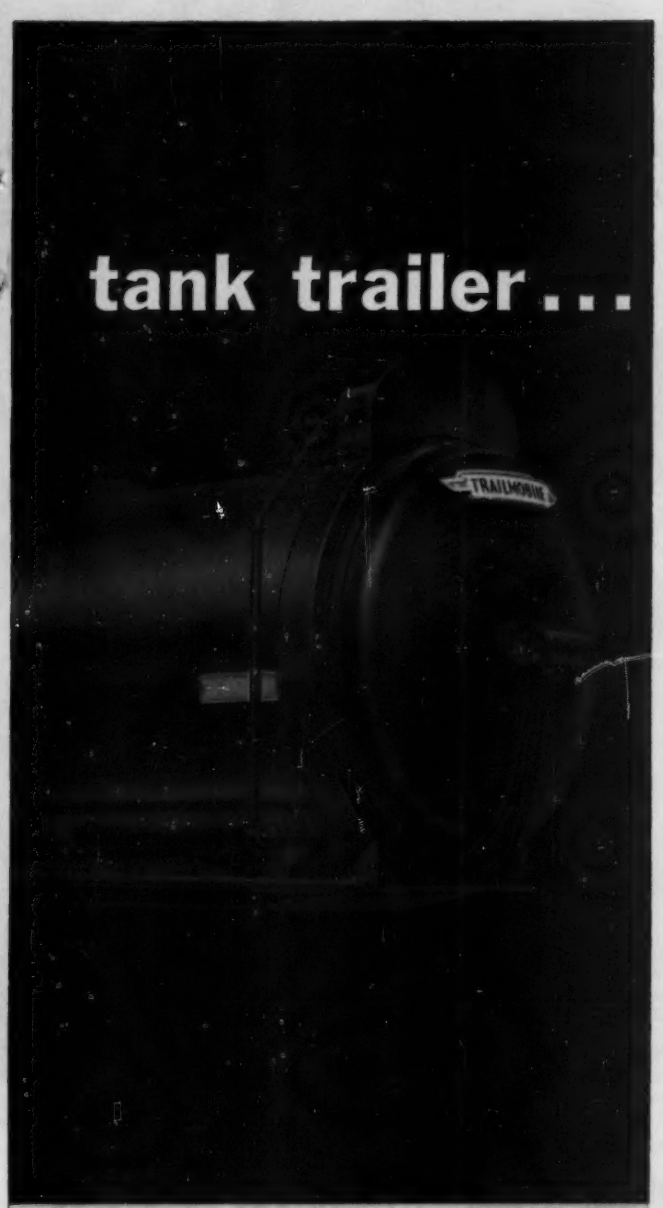
These four semi-elliptical heads are made of Type 304 stainless steel. Outside diameter: 74¼". Gauge: 2.58" minimum. Weight: Each head weighs over 3 tons.

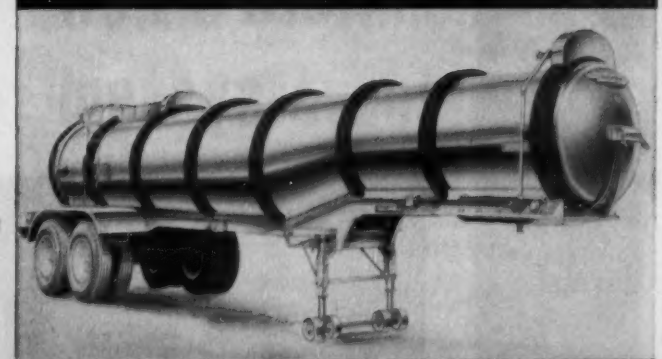
New TRAILMOBILE acid



The secret is exterior ring design!

tank trailer...





has THOUSANDS of POUNDS more payload capacity

The new Trailmobile Model CH Acid Tank Trailer gives you big, extra payload capacity amounting to as much as 100 pounds for every 100 gallons of capacity built into the tank.

The secret is exterior ring design! Brawny rings of steel reinforce the new light gauge shell allowed by regulation codes. This unique design lightens the trailer by thousands of pounds while retaining structural strength.

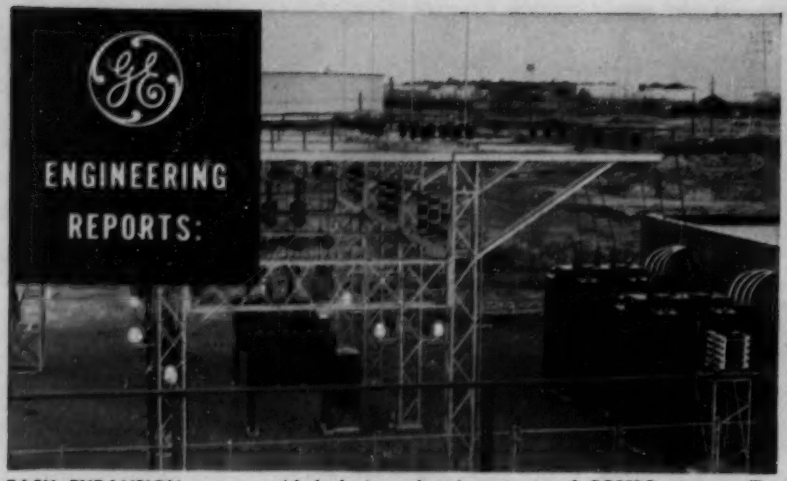
This new Trailmobile Model CH incorporates every money-saving feature of previous Trailmobile models. It is available in high tensile steel, stainless steel or aluminum with a variety of coatings and linings to handle all types of corrosive and non-corrosive fluids. Insulated models are also available where load temperatures need to be maintained.

Check on the CH before you buy. TR-478

TRAILMOBILE INC.

Cincinnati 9, Ohio • Springfield, Missouri
Longview, Texas • Berkeley 10, California

ENGINEERING REPORTS:



EASY EXPANSION was provided during planning stages of SOHIO system. For example, each of two 11,500-kva power transformers on General Electric package substation, providing 4160 v for plant distribution, can be uprated to 14,394 kva.

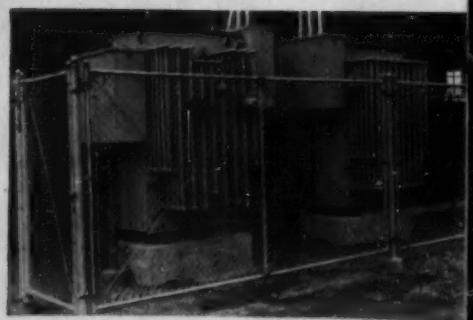
DESIGNED for outdoor process use, two General Electric totally enclosed, inert-gas-filled induction motors, with gas to water heat exchangers, drive centrifugal blowers. Total connected load of the plant's motors approximates 25,000 hp.

OVER CURRENT and short circuit protection is provided for 175 through 1000-hp motors by 4160-v Limitamp* controllers.

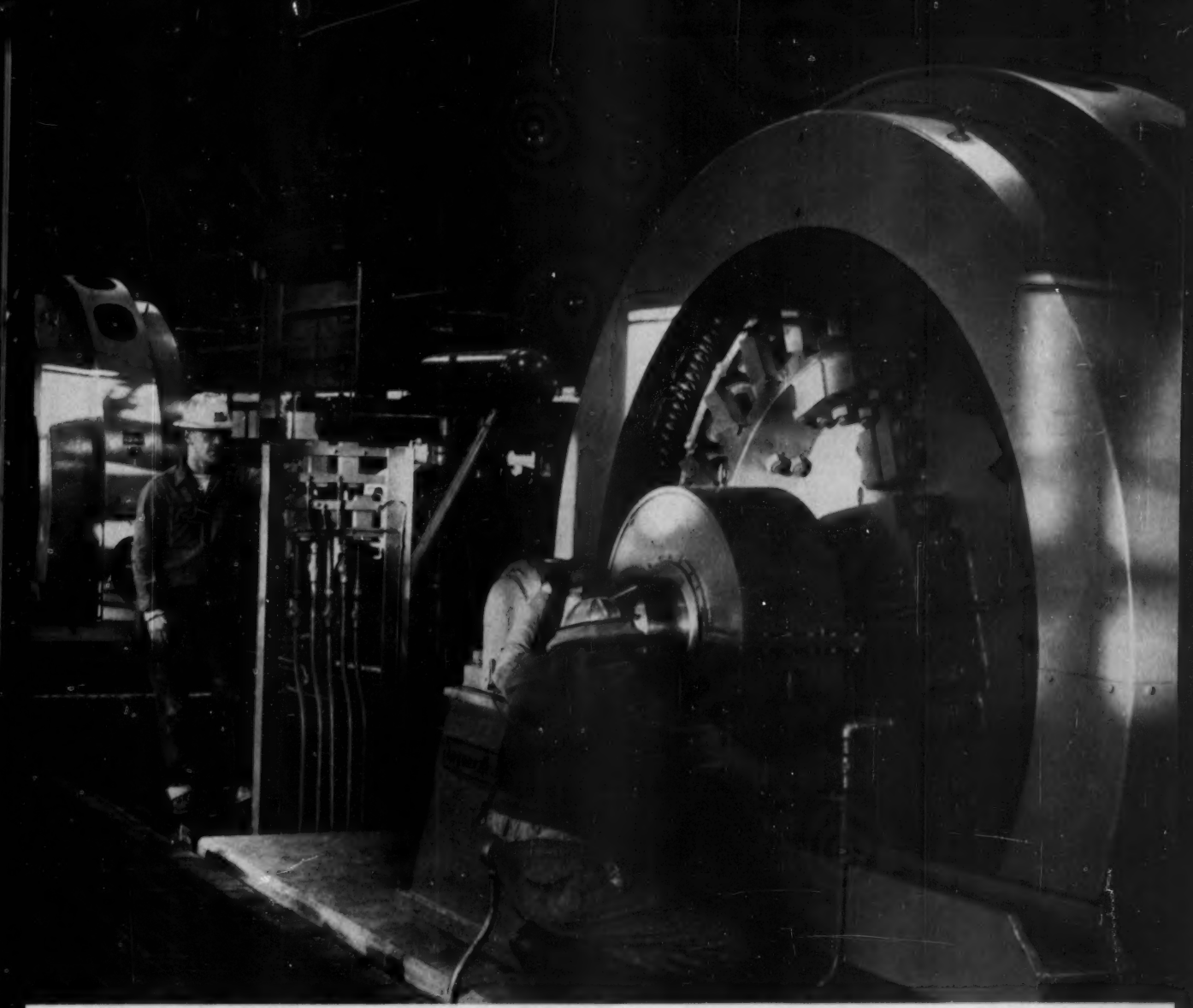
COST SAVING load center system brings higher voltages closer to load. Low voltage switchgear controls auxiliary motors.

*Reg. trade-mark of General Electric

Here's how system



SYSTEM PROTECTION through neutral grounding covers all voltage levels, including 1000-kva medium transformers.



PRESSURIZED HOUSING encloses sliprings of two 3000-hp General Electric synchronous motors driving synthesis gas compressors. Secondary selective system helps permit almost all motors in the system to have a standby power source.

SOHIO Chemical's engineered electrical helps prevent lost production

General Electric engineered system at new Lima, Ohio, petrochemical plant was planned for reliability, future expansion.

The SOHIO Chemical Company operates their new $17,000,000 petrochemical plant with a General Electric engineered electrical system planned and installed to meet present and future electrical requirements. This modern plant, designed to produce 300 tons of anhydrous ammonia per day, was engineered and constructed by The M. W. Kellogg Co., New York.

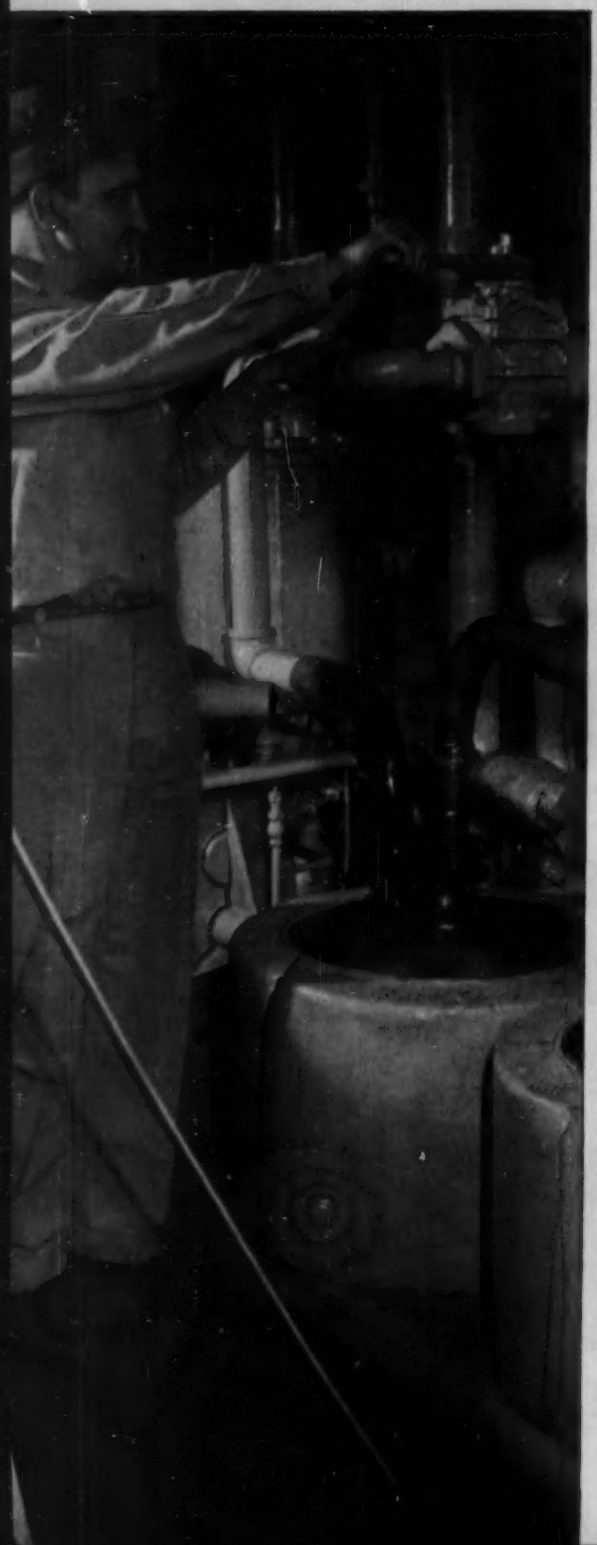
2 BASIC REQUIREMENTS were set forth by SOHIO . . . (1) reliability to help guard against lost production and (2) flexibility for future expansion. General Electric engineers worked closely with SOHIO personnel and their consultants to gain these objectives. On these pages are some highlights of the system.

WHEN YOU BUILD, or modernize, take advantage of General Electric quality-engineered electrical equipment and complete engineering services for the chemical industry. Your General Electric Apparatus Sales Representatives at the nearest G-E Apparatus Sales Office will give you complete information. Contact him early in your planning and write for bulletin GED-2244 "Engineering Services" to General Electric Co., Section 681-13, Schenectady, New York.

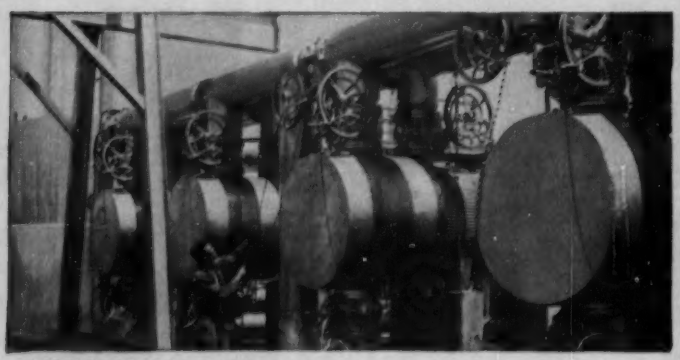
Engineered Electrical Systems for the Chemical Industry

GENERAL ELECTRIC

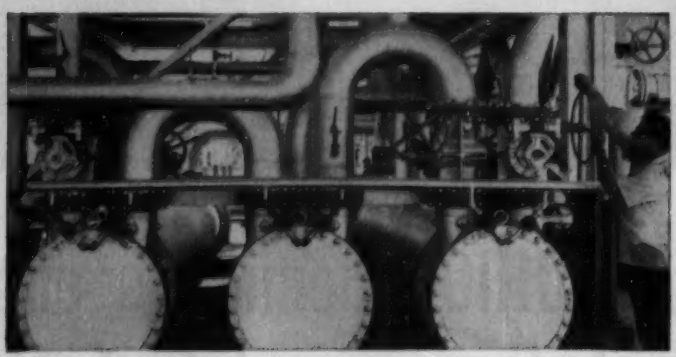
Break Production



PRECISE CONTROL on antibiotic processing at this pharmaceutical plant is assured by the fast, smooth quarter-turn operation of Rockwell-Nordstrom valves.



VERSATILE Rockwell-Nordstrom valves can be used in any position for flow in any direction. Ideal for chain-wheel or extension operating like the heat exchanger shown above.

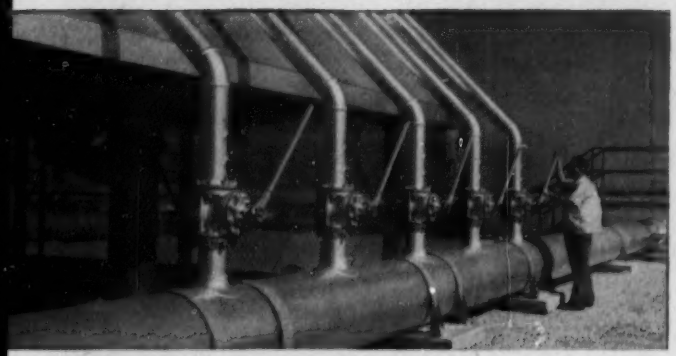


COMPACT Rockwell-Nordstrom valves on the gas coolers above have no stem assemblies or bonnet cavities to take up vital space. Space and weight savings mean real economy of designing and investment.

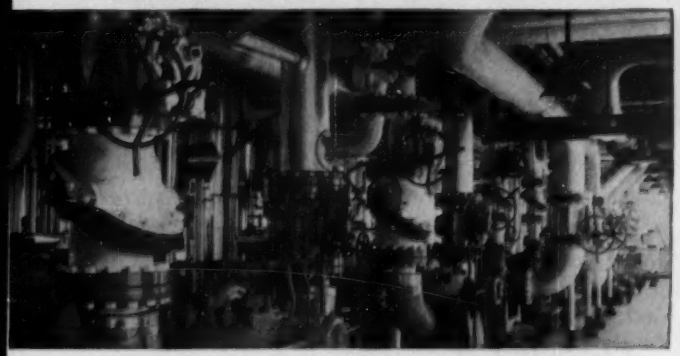
DEPENDABLE, LEAKPROOF Rockwell-Nordstrom valves cost no more, often less, than ordinary valves—but they assure absolute reliability on even the most critical service.

Bottlenecks

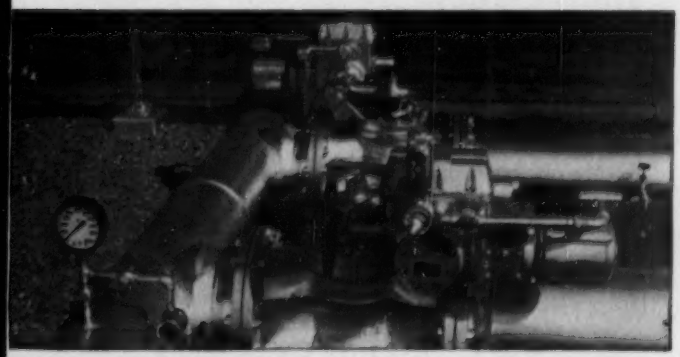
ROCKWELL-Nordstrom VALVES Keep Every Line On Stream



AT A GLANCE, you can tell whether a Rockwell-Nordstrom valve is open or closed. Costly, often dangerous guesswork and old-fashioned "feeling" a valve are eliminated.



BIG . . . BUT FAST. *Every* Rockwell-Nordstrom valve is fully opened or fully closed in one quarter-turn. On gear operated valves, this means operation is two to five times faster.



FOR POWER OPERATION, Rockwell-Nordstrom valves assure dependability and economy because simpler and less costly actuators are required for quarter-turn operation, and lubricant keeps them "ready to go."

For forty years, process engineers have insured better quality control and mechanical performance, greater safety, and lowest maintenance costs with Rockwell-Nordstrom chemical valves. They have been *proven* on every service from the earliest refineries to today's exacting demands of precise flow control in automatic chemical and processing plants. The facts speak for themselves . . . everywhere you use Rockwell-Nordstrom valves they will assure you greater "on stream" dependability at lower cost than any other valve you have ever used.

Look at these installation photographs for just a few of the reasons why Rockwell-Nordstrom valves can help you break production bottlenecks. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Canadian Valve Licensee: Peacock Brothers Limited

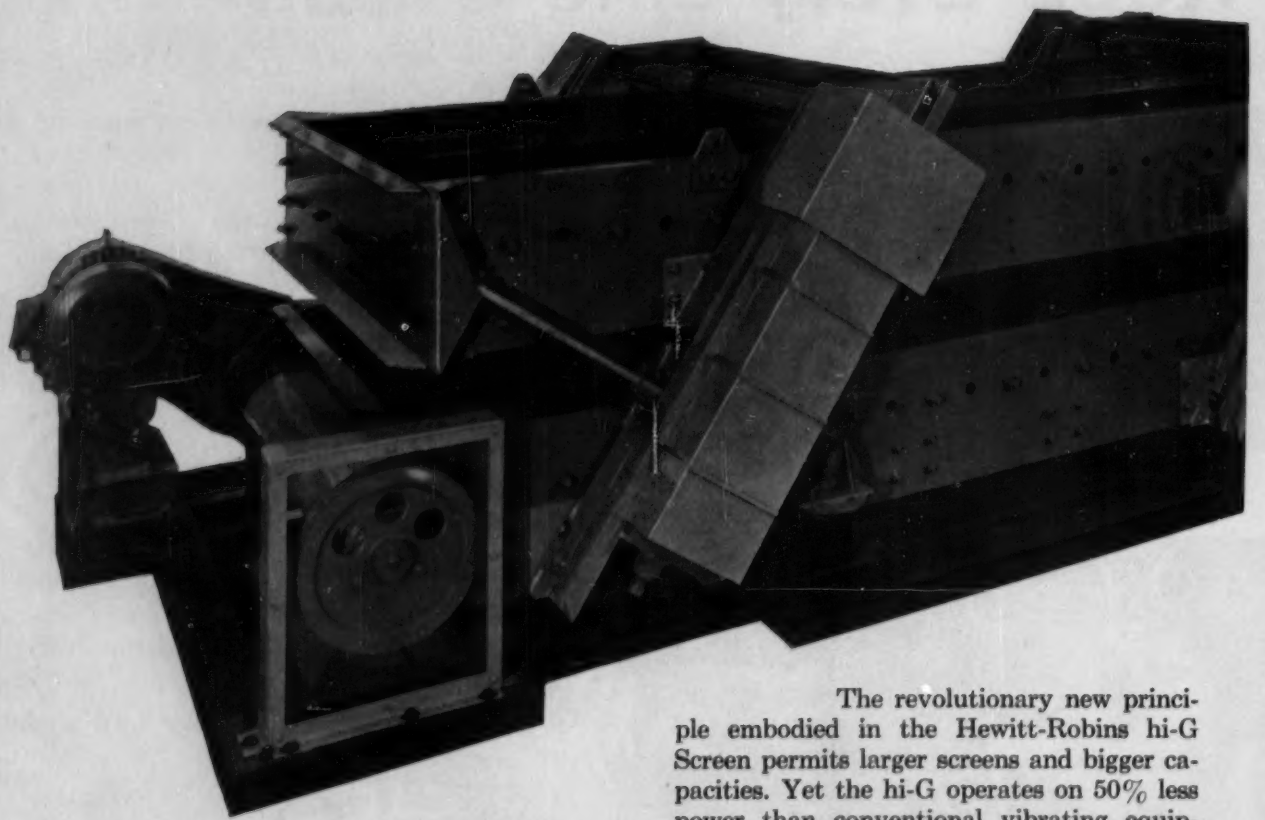
ROCKWELL-
Nordstrom
VALVES

Lubricant Sealed For Positive Shut-Off

40th YEAR *of lubricated plug valve leadership*

HEWITT-ROBINS *hi G* SCREENS

50 Per cent Savings



The revolutionary new principle embodied in the Hewitt-Robins hi-G Screen permits larger screens and bigger capacities. Yet the hi-G operates on 50% less power than conventional vibrating equipment! Even screens as large as 6' wide by 28' long require no more than a 20-HP drive.

Featuring an unusually sharp screening action, and a choice of stroke and speed combinations, the hi-G can be made in larger sizes than any other vibrating screen on the market.

New "Modified Resonance" Principle

Utilizing the principle of "modified reso-

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PRODUCTS

VIBRATING SCREENS • VIBRATING CONVEYORS
CONVEYOR BELTING • CONVEYOR MACHINERY
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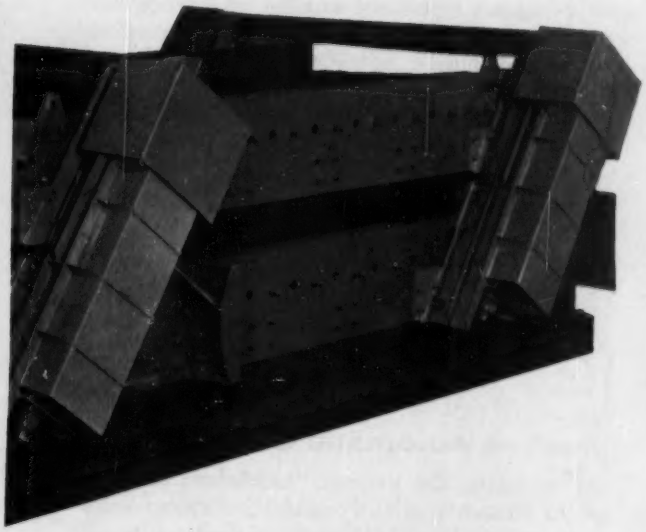
ENGINEERING AND ERECTION OF COMPLETE
BULK MATERIALS HANDLING SYSTEMS
"JONES" POWER TRANSMISSION EQUIPMENT
"GLIDE RIDE" THE NEW MOVING SIDEWALK

HEWITT

STAMFORD,

SAVE POWER *Possible*



nance," the new Hewitt-Robins hi-G Screen develops a controlled, extremely sharp vibrating action. This resonance is induced by a relatively small mechanical exciter producing powerful vibrations with added "kick" to separate materials according to size.

If you need larger screens—screens that operate on or near the horizontal and still screen at large openings—*screens with readily accessible lower decks for easy observation, spraypipe installation and quick cloth changes* . . . the hi-G Screen is your answer. For information about hi-G Screens and other Hewitt-Robins vibrating equipment, contact our nearest sales office or write to our offices in Stamford, Connecticut.

-ROBINS

CONNECTICUT

HEWITT-ROBINS VIBRATING EQUIPMENT FOR CHEMICAL PROCESSING

GYREX SCREENS. General-purpose, positive-stroke, 4-bearing screen with amazing versatility of application and an unsurpassed record for stamina in service.

STYLES M AND MS VIBREX SCREENS. Full-floating, unbalanced, pulley-type, 2-bearing screen. Offers sharp sizing of a wide variety of materials at low cost.

STYLE J VIBREX SCREENS. General-purpose screen applicable to a wide variety of screening operations. Wide range of sizes for suspended mounting.

STYLE HS HIGH-SPEED VIBREX. For fine screening applications (up to 100-mesh in some cases). Highly effective circle-throw screening action.

ELIPTEX SCREENS. Exclusive 3-way elliptical motion for sharpest sizing and most effective dewatering. Horizontal-operating flat screens.

CAR SHAKEOUTS. Both Heavy-Duty and General-Service units for unloading all sorts of materials from hopper cars faster, more efficiently and more economically.

VIBRATING FEEDERS. Fully mechanical vibrating feeder. Easy to install, operate and maintain. Extremely high capacities at very low power consumption.

VIBRATING CONVEYORS. To convey practically any substance in almost any form or condition. Available in several widths up to 150 feet in length with only one vibrator.

SCREEN CLOTH. Wire cloth in a variety of sizes, weaves and materials for virtually every sizing, separating or screening operation.

FOR SERVICE AND INFORMATION ON BELTING AND HOSE CALL YOUR LOCAL HEWITT-ROBINS INDUSTRIAL SUPPLY DISTRIBUTOR LISTED IN THE "YELLOW PAGES"

AUTOMATIC CONTROL OF

• A REEVES engineering report on a new control that completely automates mechanical variable speed . . . accurately controls and integrates processing variables

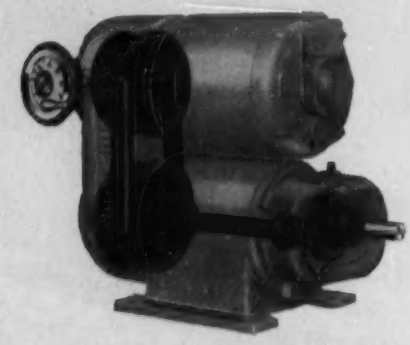
New Control Demands

Recently, with the intensified interest in automating production and processing lines, there developed many new measuring instruments whose signals had to be translated into automatic control of variable speed drives. These signals reflected changes in many variables—such as pressure, flow, weight, level, color, light intensity, radio-activity and peripheral speed.

The instrumentation industry has been ingenious in developing devices to sense and measure these variables, translating them into the industry standard of 3 to 15 psi air pressure; each equal increment of change in psi representing a linear change in the measured signal.

The need, then, has been for some type of automatic control to accurately and continuously transfer the instrument air signal to equally proportioned changes in the output speed of the variable speed drive.

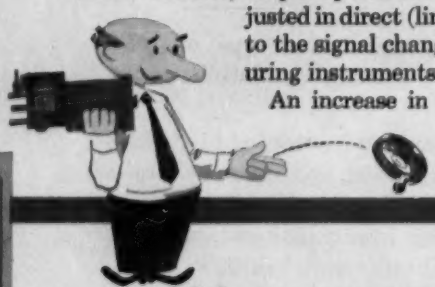
The most logical choice for the basic mechanical variable speed drive is the versatile and efficient REEVES Motodrive . . . an inexpensive power package that combines the motor, variable speed mechanism and gear head reducer into one compact unit. The Motodrive operates on the time-tested principle of a V-belt driving between two pairs of cone-shaped discs which are adjustable to form an infinite number of driving and driven pitch diameters to give variable speed at the output shaft.

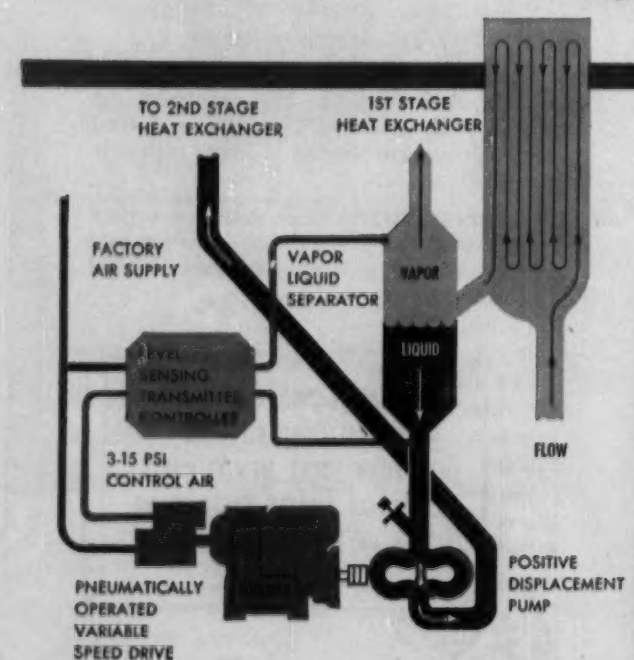


Reeves Automatic Control

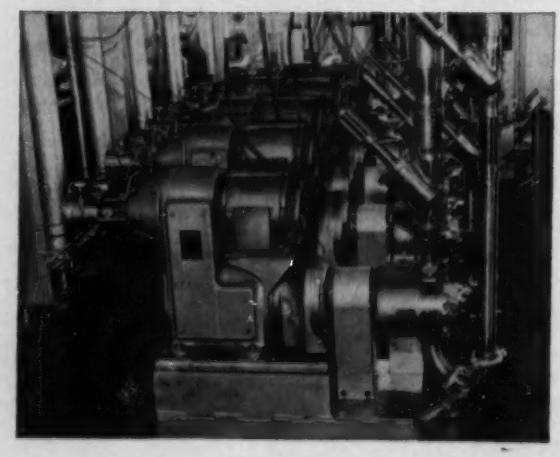
By replacing the manual "handwheel control" of the Motodrive with a pneumatic REEVES Automatic Control, output speeds are continually adjusted in direct (linear) proportion to the signal changes of the measuring instruments.

An increase in the instrument





How one plant

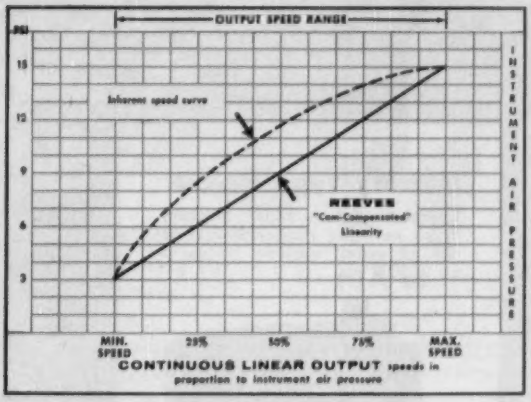


VARIABLE SPEED DRIVES

control pressure activates a valve, admitting supply air to a cylinder chamber. This force against the air piston in the cylinder moves the speed shifting mechanism of the REEVES Motodrive to increase the output speed.

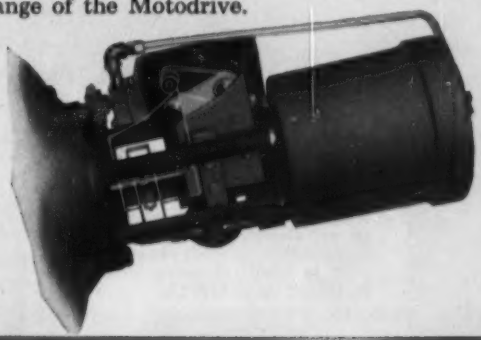
A decrease in control pressure exhausts air from the cylinder chamber, causing a decrease of the output speed. Any change, therefore, in control pressure of the measuring instrument gives an automatic corresponding change in the output speed of the REEVES Motodrive . . . resulting in exact processing control.

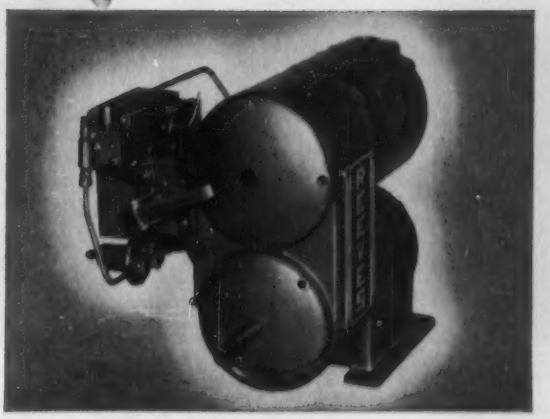
Cam-Compensated Design



The output speed of this type of variable speed drive with standard controls is in the form of a curve.

The REEVES Automatic Motodrive incorporates a cam to control output speeds in direct (straight line) proportion to instrument air signal variations. This cam is contoured to produce linear speed changes over the entire output speed range of the Motodrive.





utilizes this Reeves Control

Evaporating the natural waters from fruits to produce fruit concentrates has greatly reduced the cost of packing and shipping of fruits.

Great care must be exercised in the exposure of the fruit pulp to temperature and pressure to retain the natural flavor.

A recently designed and remarkably fast one-pass process incorporates REEVES Automatic Motodrives to automatically control the critical relation between concentrate density and rate of flow.

As water is evaporated from the fruit pulp, the smaller volume reflected by the dropping level in the liquid-vapor separator is sensed by a pressure differential transmitter.

Converted to 3-15 psi air, this signal works through the automatic controller to reduce the speed of the REEVES Motodrive and, in turn, the speed of the constant displacement discharge pump.

The REEVES Automatic Motodrive, used in connection with modern instrumentation, is your answer to flexible, sensitive, accurate speed control for automatic processes.

We don't know *all* the possible applications for this control . . . but our engineers will be glad to work with you on *your* processing problems.
For more details write for Bulletin CE25-M542.

REEVES DIVISION • COLUMBUS, INDIANA
RELIANCE ELECTRIC AND ENGINEERING CO.

GET THE BEST SOLUTION TO EVERY FLOW

. . . with Foxboro Instrumentation

Differential Pressure Cell Transmitters

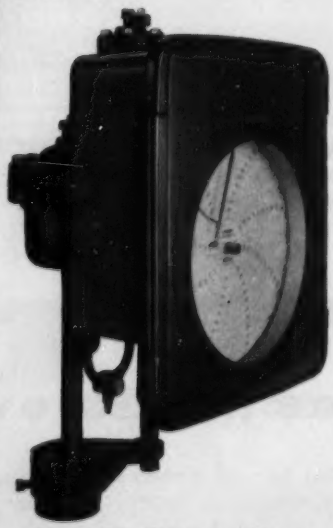
Complete line includes air-operated and electric-operated d/p Cell Transmitters covering ranges from 0-20" to 0-800" of water; working pressures up to 1500 psi.

Type 13A d/p Cell Transmitter

- **Positive Overrange Protection—up to full 1500 lb. rating**
- **Fully Adjustable Ranges—0-20" to 0-80" and 0-50" to 0-250" water**
- **Automatic Internal Damping — fast, stable measurement**
- **Simplicity—easiest, lowest-cost installation, lowest maintenance**

Mercury Type Meters

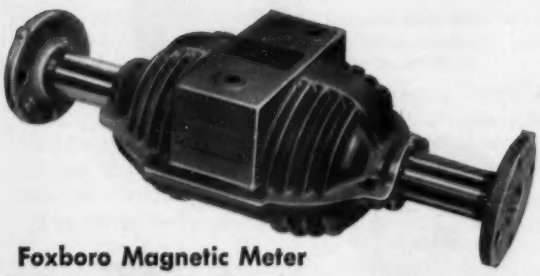
Complete line includes mercury types covering ranges from 2 to 400" of water; working pressures up to 5000 psi.



Type 28 Mercury Meter

- **Permanent Full-Scale Meter Accuracy — exclusive segmental lever design provides linear transmission from float to pen**
- **Highest-Powered Pen Drive — large float with long travel**
- **Minimum Ambient Temperature Effects — float located in high pressure chamber**

PROBLEM



Foxboro Magnetic Meter

- Measures Fluid Velocity Directly
- Adds No Pressure Drop
- Uniform Flow Scale
- Overall Accuracy Better than 1% of Range Over Entire Scale
- Full Accuracy Sustained Even on Liquids Other Meters Can't Handle — even sand and water slurries

THERE ARE two logical reasons why Foxboro Instrumentation assures you *optimum* results in measurement or control of process fluid streams. First; Foxboro offers the widest variety of measuring and controlling devices . . . the *right* equipment for every application. For example, only Foxboro offers all these basic meter types: differential pressure cell flow transmitters, magnetic meters, mercury meters, and weir meters. Second; Foxboro provides 45 years of engineering experience in every phase of fluid mechanics. From the simplest general utility-type instrument to complex automatic ratio control systems, you get highest accuracy, efficiency, and economy. Whenever you have a flow problem involving liquids, vapors, gases, or slurries — in pipes, ducts, or channels, you can solve it best by specifying Foxboro. Only a few instruments are described on these pages. For full details; or for specific information on *your* problem, contact your nearby Foxboro Field Engineer, or write The Foxboro Company, 368 Neponset Ave., Foxboro, Mass.

FOXBORO

REG. U. S. PAT. OFF.

FIRST IN FLOW

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

Float-and-Cable Type Meters

- Rigid Construction — weather-tight case; all working parts of corrosion-resistant materials
- Powerful Accurate Operation — large, high-stability float; cable of Type 302 Stainless Steel—non-stretching, non-twisting
- Direct Reading Chart and Scale
- Direct Reading Integral Counter

Other Foxboro Flow Instrumentation

Electric or Pneumatic Type Rotameters

Electric, Pneumatic, and Mechanical Integrators

Planimeters

All Primary Elements, Valves, and Accessories required for assembly of complete flow measurement and control systems

Pump standardization

1 YOUR CHOICE OF MATERIALS OF CONSTRUCTION

All iron

All bronze

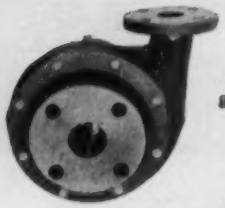
All Worthite

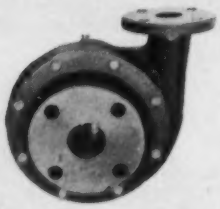
Iron with bronze impeller and trim

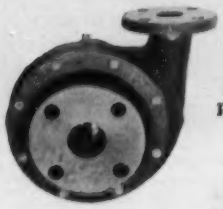
Steel with iron impeller and trim

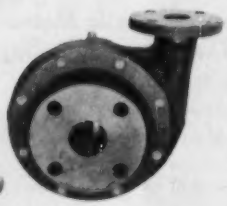
Steel with bronze impeller and trim

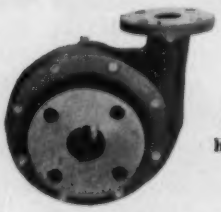
2 YOUR CHOICE OF LIQUID ENDS


With closed impellers for general service


With open impellers for general and abrasive services


With closed impellers for process service


With open impellers for corrosive services

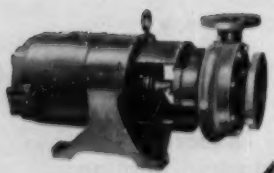

With closed impellers for hotwell service

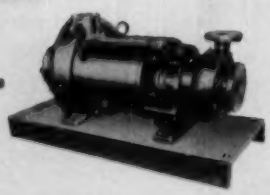
3 YOUR CHOICE OF SHAFT SEALING METHODS

Stuffing box

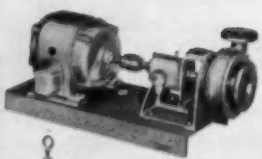
Mechanical seal

4 YOUR CHOICE OF DRIVES


Monobloc Motor


Monobloc Turbine

CLOSE-COUPLED


Direct Motor Drive

Direct Turbine Drive

Belt Drive

FRAME-MOUNTED

Choose from 70,480 combinations. Worthington's SESC—Standard End Suction Centrifugal—line allows you to "custom-build" your pump from stock parts. In each of the 120 sizes, you have a choice of materials of construction, types of liquid ends, shaft sealing methods, and drives. Because the SESC line is built from standard, stocked parts, you get prompt delivery at competitive prices.

slashes inventory, reduces downtime, cuts maintenance

. . . yet gives you 70,480 combinations to choose from

STANDARDIZE AND SAVE! NOT SOMETIME IN THE FUTURE, BUT NOW!

With Worthington's SESC—Standard End Suction Centrifugal—line, you can cut your warehousing and inventory costs as much as 50%, greatly simplify pump maintenance, and reduce downtime.

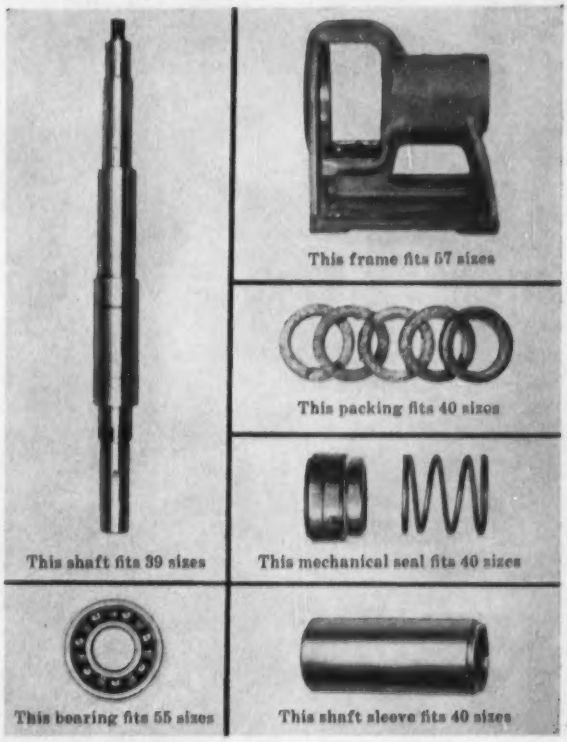
You get these benefits *without* sacrificing flexibility. In fact, the SESC line gives you an even broader selection. Because *parts* have been standardized and not *pumps* you can literally "custom-build" your pump to get exactly the right features for your particular application.

The complete Worthington SESC pump line consists of six separate types, all suitable for either motor, turbine, or belt drive. Ratings range up to 2700 GPM and 230 ft. head. Pumps and spare parts are available from field stock in all strategic areas as well as from the factory.

If you'd like to know more about the SESC line, write to Section PC61, Worthington Corporation, Harrison, N.J. In Canada: Worthington (Canada) 1955, Ltd., Toronto, Ont.

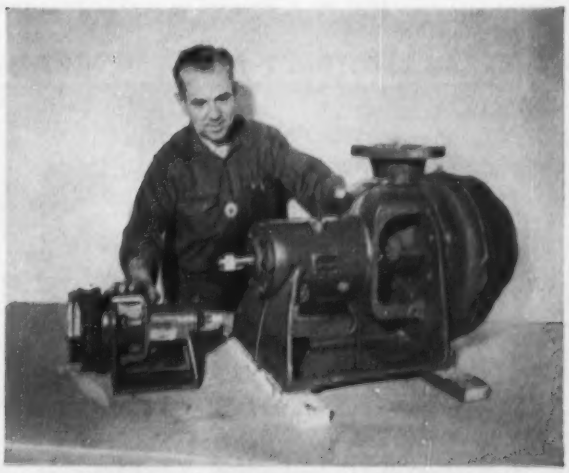
PC-6.1

WORTHINGTON

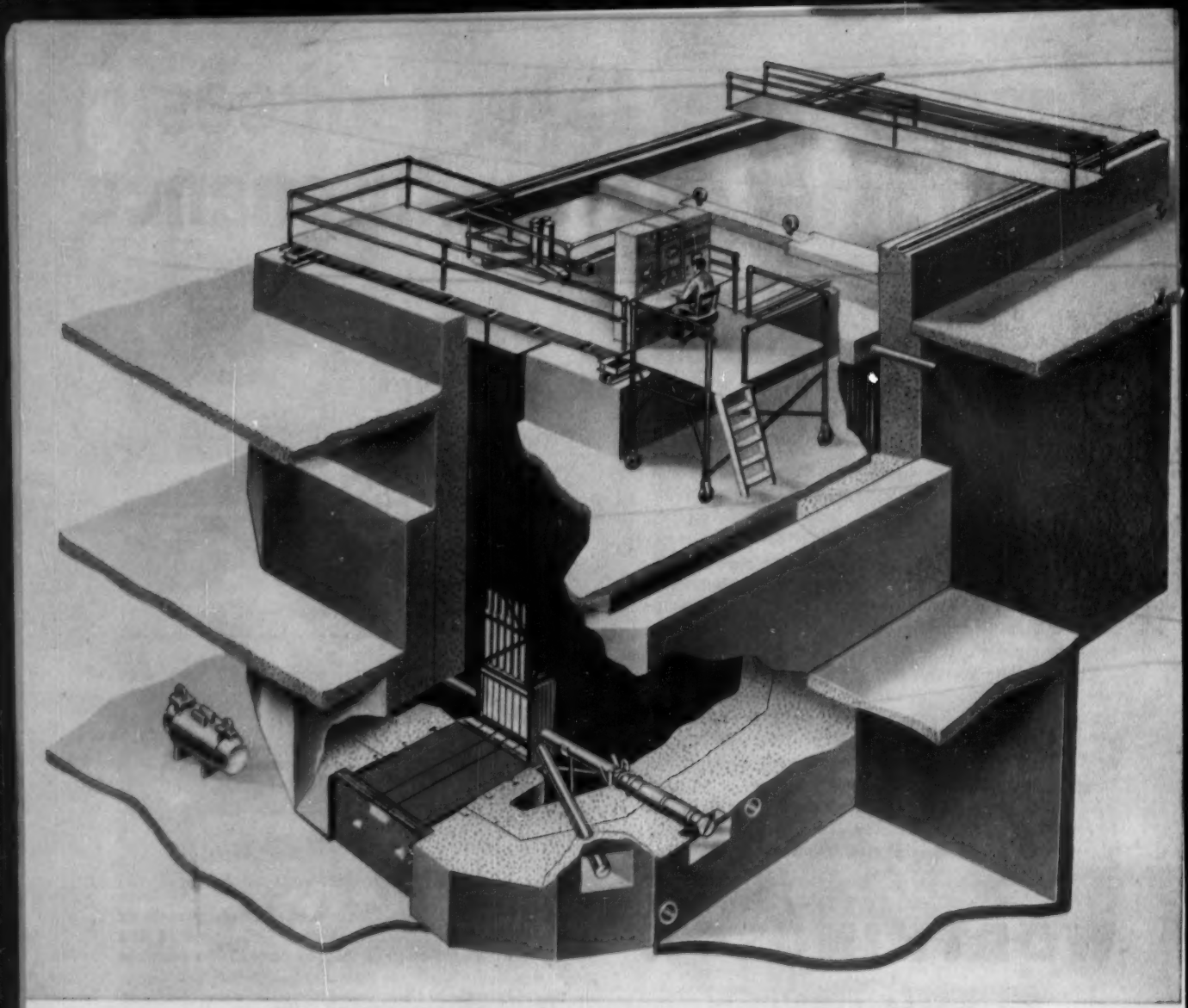

This frame fits 57 sizes
This packing fits 40 sizes
This shaft fits 39 sizes
This mechanical seal fits 40 sizes
This bearing fits 55 sizes
This shaft sleeve fits 40 sizes

Slashes parts inventory. You can cut inventory costs as much as 50% by standardizing on the SESC—Standard End Suction Centrifugal—line. In the 120 sizes in the complete line, many, many parts are interchangeable. As shown here, one shaft is used in 39 sizes, one bearing in 55 sizes, one frame in 57, one packing in 40, one mechanical seal in 40, and one shaft sleeve in 40 sizes.

Reduces downtime. Parts interchangeability can mean big savings. When repairs or conversions are necessary, standardization can often drastically cut downtime. For example, all SESC pumps can quickly be converted from packed stuffing box to mechanical seal and vice versa using *stock* parts.

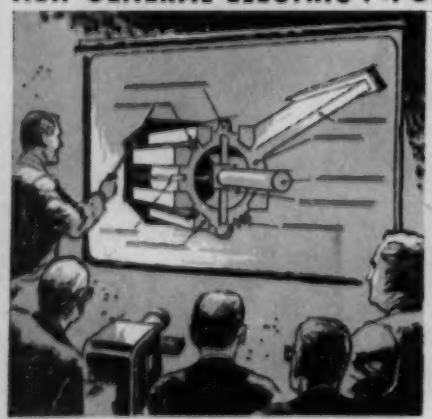


Cuts maintenance. If you know one SESC pump, you know them all. From the smallest to the largest the entire line is built to the same basic design. Maintenance men quickly become familiar with construction details. Their work is simplified and maintenance costs greatly reduced.



SWIMMING POOL REACTOR, one of three G-E research reactors available under the 7-point program, is designed to produce large quantities of neutrons. Its flexibility, safety features, and high flux potential appeal to universities and research organizations.

NEW GENERAL ELECTRIC 7-POINT PROGRAM:



1 REACTOR SPECIFICATIONS are prepared to meet your research requirements. These include details on core, control, and reactor components.

2 BUILDING STUDY also includes complete co-ordination of all plans for the many facilities required in the reactor and laboratory buildings.

3 HAZARDS SUMMARY REPORT: We help you prepare study for submission to AEC Division of Civilian Application.

How General Electric can help you enter advanced nuclear research fields

New G-E 7-point program simplifies procedure for obtaining a nuclear research reactor

There is more work involved in obtaining a nuclear reactor for advanced research than simply ordering one. Specific research requirements must be determined beforehand, an appropriate design selected, and necessary AEC construction permits and licenses obtained. Other essential steps are covered in the program outlined below.

NEW GENERAL ELECTRIC 7-POINT PROGRAM is a plan designed to materially aid you in putting a research reactor to work. Through this program you can obtain any one of three General Electric research reactors: The Swimming Pool Reactor, Heavy Water Research Reactor, or the Nuclear Test Reactor.

FOR MORE INFORMATION on these three research reactors and the new General Electric 7-point program, write for bulletin GEA-6326, General Electric Company, Section 191-1, Schenectady 5, N. Y.; or contact your nearest G-E Apparatus Sales Office. Outside the U.S. and Canada, write to: International General Electric Co., 570 Lexington Ave., New York, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

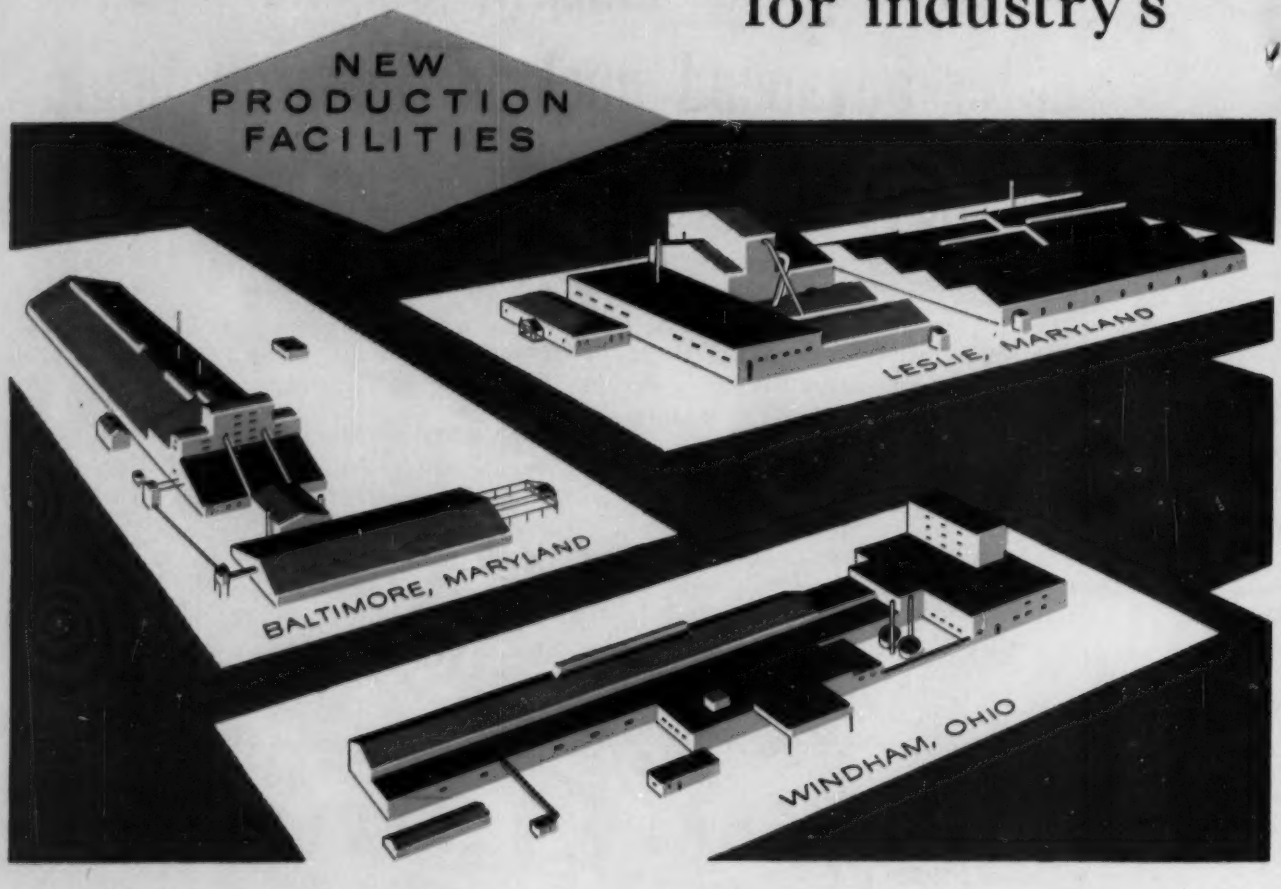
4 MANUFACTURE OF REACTOR is accurately co-ordinated with other construction plans, thereby assuring centralized project scheduling.

5 REACTOR INSTALLATION is supervised at the site by the men who have followed the design and manufacture of the complete system.

6-7 START-UP AND SERVICE under supervision of experienced personnel is added assurance that proper operation of your system will be maintained.

Harbison-Walker BUILDS

for industry's

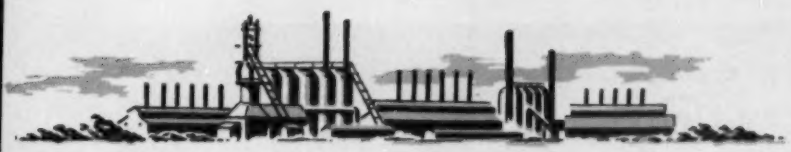


RAPID GROWTH and evolutionary changes in substantially all industrial processes necessitate similar progress in the production of refractories. In order to meet industry's increasing demands and in anticipation of even greater and more exacting future requirements, Harbison-Walker has conducted a continuous program of expansion and modernization. Consistent with this policy, a number of new plants have been built, some of which are here illustrated. Other new plants are under construction at Ludington, Michigan and Hammond, Indiana, the former for the production of dead-burned magnesia of unusually high purity, and the latter for the manufacture of basic brick and other basic refractories. Both will be provided with docks for water shipment. These two new additions provide Harbison-Walker with a total of 36 plants in the United States, Canada, Peru and Mexico. The Company operates scores of mines and quarries located in these areas.

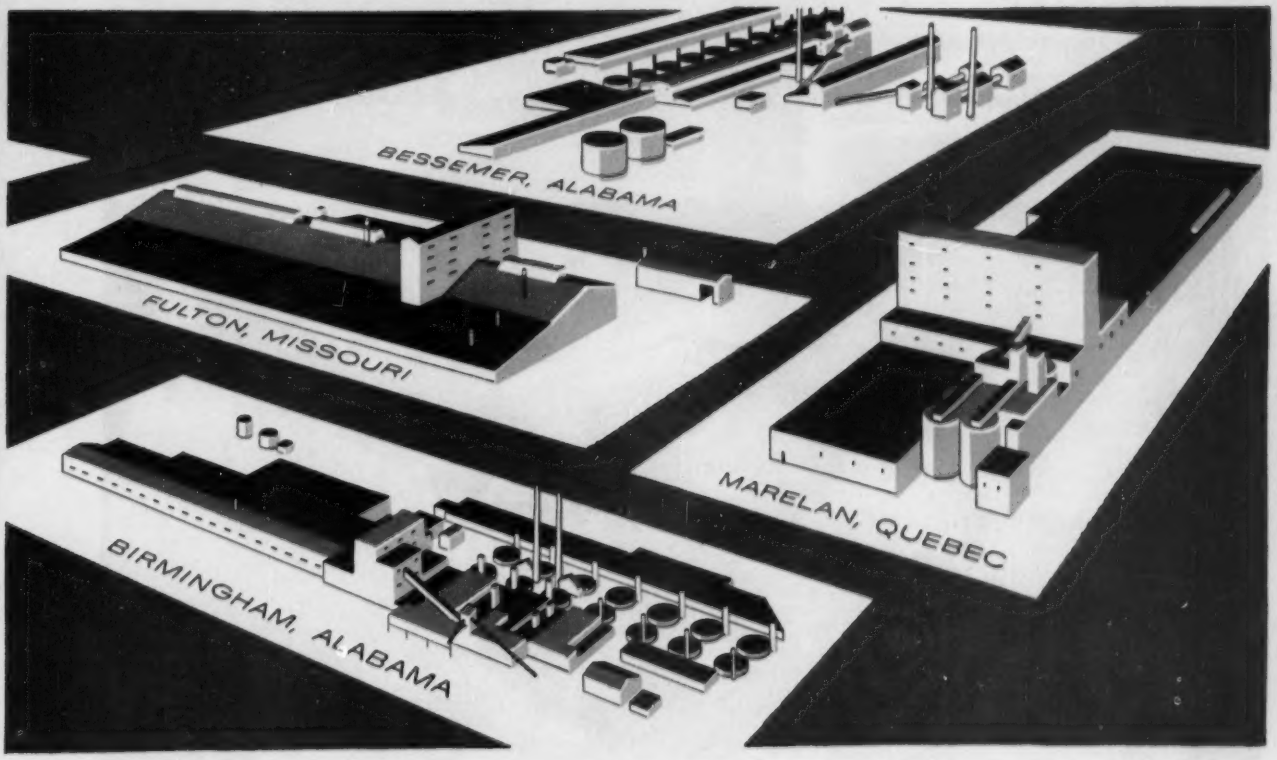
In addition, the production capacities of other plants have been materially increased with the benefit of the most modern facilities. These widely distributed plants are located at Warm Springs, California; Athens, Texas; East Chicago, Indiana; Olive Hill, Kentucky; Portsmouth, Ohio; and Clearfield, Pennsylvania. Further expansion will follow as required.

Coupled with this large expansion is an accelerated research program. A new greatly enlarged central research laboratory will be built in Pittsburgh and the present laboratory then will be converted entirely to Quality Control. Among the main research objectives is the development of new types and classes of refractories needed for new processes and for withstanding more severe service conditions. Another important research accomplishment is the continual enhancement of properties of conventional refractories. Laboratory research is closely co-ordinated with extensive studies of the performance of various refractories in the many kinds of metallurgical and other industrial furnaces.

Harbison-Walker has consistently kept pace with



future refractories needs



industry by the development and adoption of new and improved manufacturing methods. The most modern and precise production processes are used. The present Quality Control Program exceeds anything previously employed in the refractories industry.

These Harbison-Walker progressive accomplishments contribute greatly to better refractory practice for industry. To the producers of iron and steel, aluminum, copper and other non-ferrous metals, cement, glass, chemicals and steam power, better refractories mean longer furnace life, less maintenance and reduced operating costs.

HARBISON-WALKER SERVES ALL INDUSTRIES WITH ALL TYPES AND CLASSES OF REFRACTORIES

ALUMINA-SILICA BRICK—Super-duty, high duty and all other classes of fireclay brick.

HIGH-ALUMINA BRICK—All classes 50% to 99% Al_2O_3 inclusive.

SILICA BRICK—Super-duty and conventional.

BASIC BRICK—Metalkase, periclase, magnesite, chrome, forsterite, chrome-magnesite and magnesite-chrome.

INSULATING REFRACTORIES • PLASTIC AND CASTABLE REFRACTORIES • HIGH TEMPERATURE BONDING MORTARS • REFRACTORY RAMMING MIXTURES • GRAIN AND LUMP SIZE REFRACTORY MATERIALS

The World's Most Complete Refractories Service

HARBISON-WALKER REFRACTORIES CO.

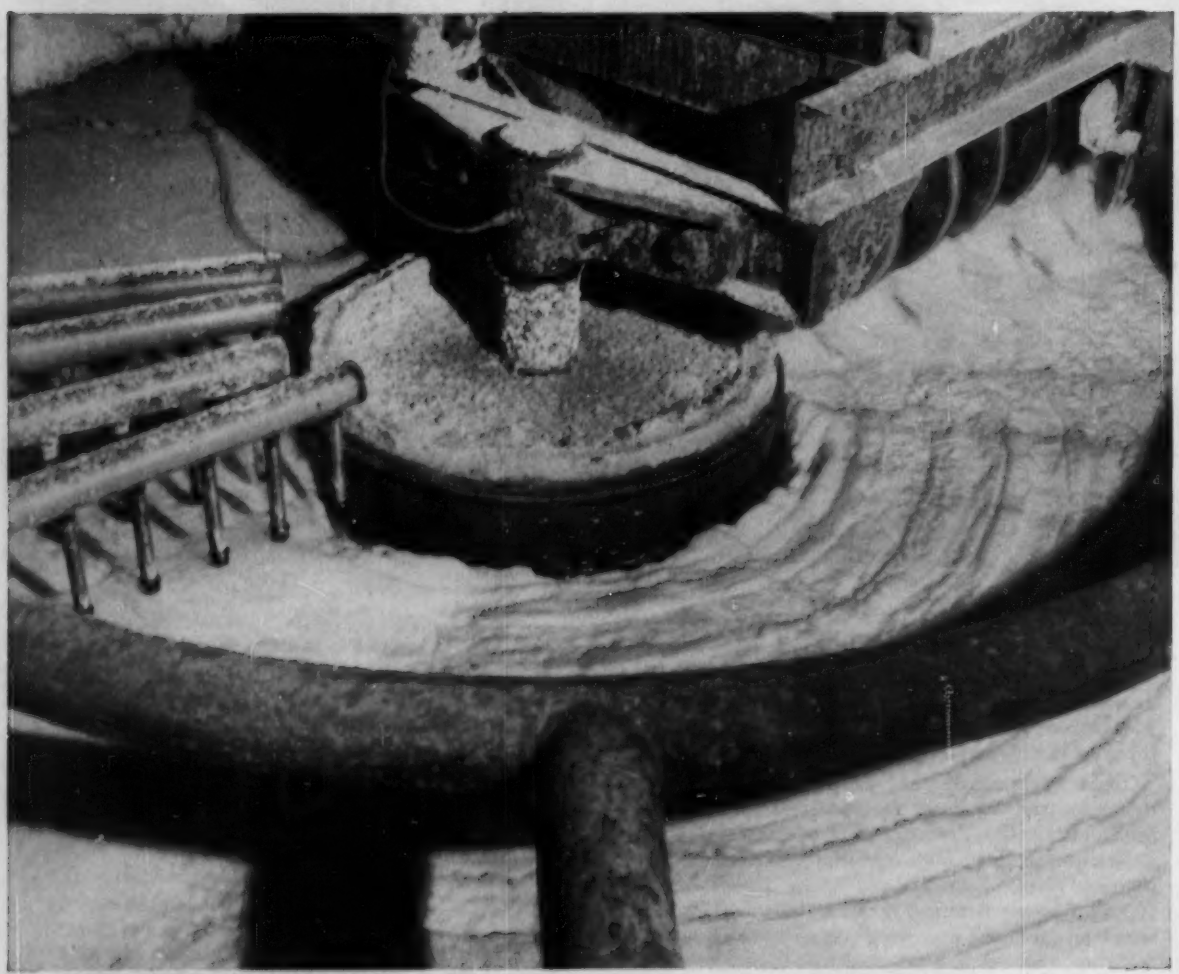
AND SUBSIDIARIES

GENERAL OFFICES: PITTSBURGH 22, PENNSYLVANIA

OFFICES AND WAREHOUSES IN PRINCIPAL CITIES

West End doubles capacity of sodium sulfate plant

Acceptance of West End Sodium Sulfate has spread so rapidly that we are enlarging our plant to produce over 100,000 tons a year. Even at this rate we are tapping less than 50% of our natural raw material supply. This output and reserve provides industry with a dependable source of highest quality sodium sulfate to serve its growing needs. Samples, prices and freight schedules will be submitted gladly on request. Please include specifications.

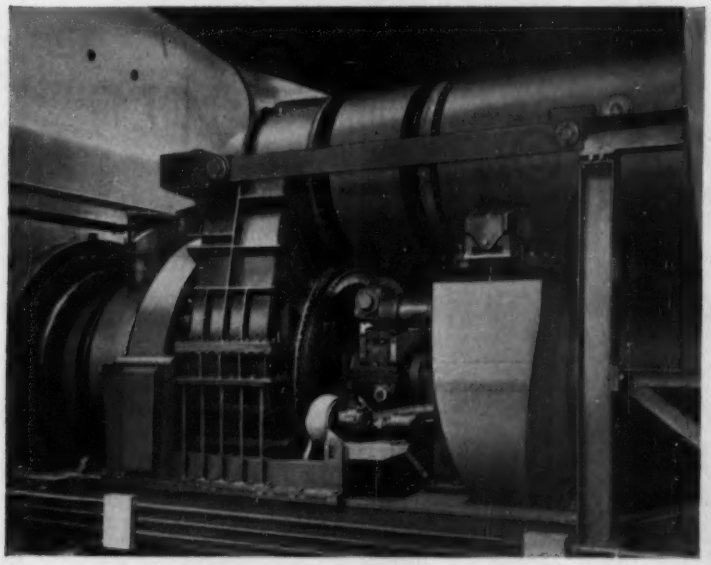


WEST END

West End Chemical Company

SODA ASH • BORAX • SODIUM SULFATE • SALT CAKE • HYDRATED LIME

EXECUTIVE OFFICES, 1956 WEBSTER, OAKLAND 12, CALIFORNIA • PLANT, WESTEND, CALIFORNIA



Clark 8500 BHP Gas Turbine for centrifugal compressor, generator or pump drive.

GAS TURBINES + CENTRIFUGAL COMPRESSORS

Only CLARK builds both!

Now you can get centrifugal compressors and modern gas turbines to drive them *exclusively* from one manufacturer . . . Clark.

In addition to saving money and headaches, you'll get proved, matched-performance "packages" specifically designed for continuous trouble free service.

Whether you have a million or a billion cubic feet of air or gas per day to handle at pressures of up to 4500 pounds per square inch, there is a Clark centrifugal compressor and in most cases a matching Clark gas turbine to drive it.

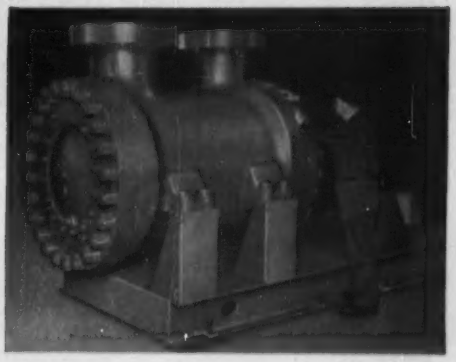
Your nearest Clark representative will be pleased to give you all the facts.

CLARK BROS. CO., OLEAN, N. Y.

One of the Dresser Industries

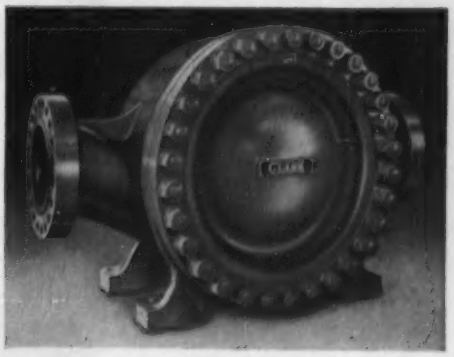
Offices in Principal Cities throughout the World

Clark Barrel Type Centrifugal Compressors for extremely high pressures.



Clark Multi-Stage Centrifugal Compressors designed for process applications.

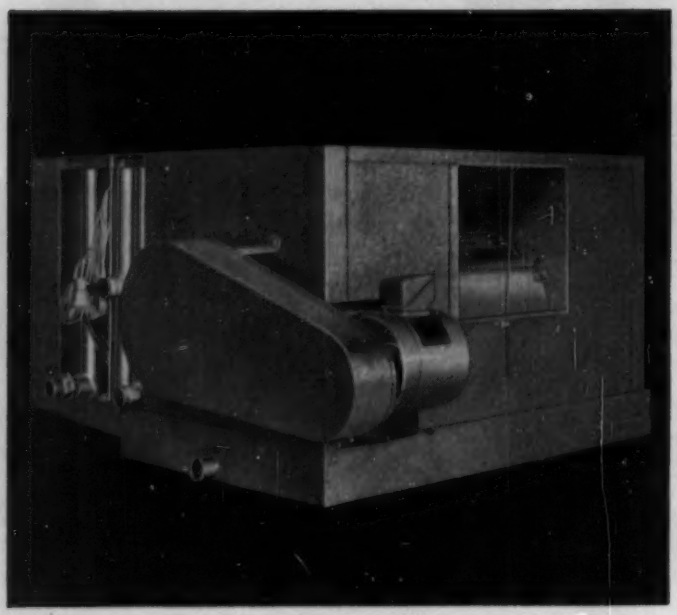
Clark Centrifugal Pipeline Booster for low ratios and high pressures.



CLARK®

GAS TURBINES
CENTRIFUGAL COMPRESSORS

AMERICAN BLOWER OFFERS FLEXIBILITY AND HIGH EFFICIENCY IN EQUIPMENT TO AIR CONDITION ANY SPACE



American Blower central-station cabinet-type air conditioning units cool and dehumidify in summer using chilled water, direct-expanded refrigerants, or brines; and heat and humidify in winter with steam or hot water. Quiet slow-speed fans, aileron air-volume adjustment, and air-mixing dampers combine high efficiency with accurate control to assure perfect year-round temperatures at low operating cost.

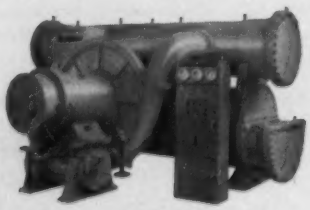
Built in sections of heavy-gauge zinc-coated steel, these units resist corrosion, make handling and erection easier. Filter boxes, piping, air discharges, and standard motors can be positioned *during installation* to meet requirements exactly. They occupy a minimum of space relative to output (capacities: 600 cfm to 48,000 cfm), and are available in horizontal or vertical arrangements, for floor or ceiling mounting.

For full details on American Blower air conditioning equipment—contact our nearest branch office, or write us direct.

Whatever type air conditioning system you plan, we have equipment to meet your exact requirements

Packaged Air Conditioners—Durably finished, quiet operating, 3- thru 20-ton capacities.

Diaflo Room Units, for floor or ceiling mounting, offer exclusive fan design, throwaway or cleanable-type filters. Enclosures lift off by hand.



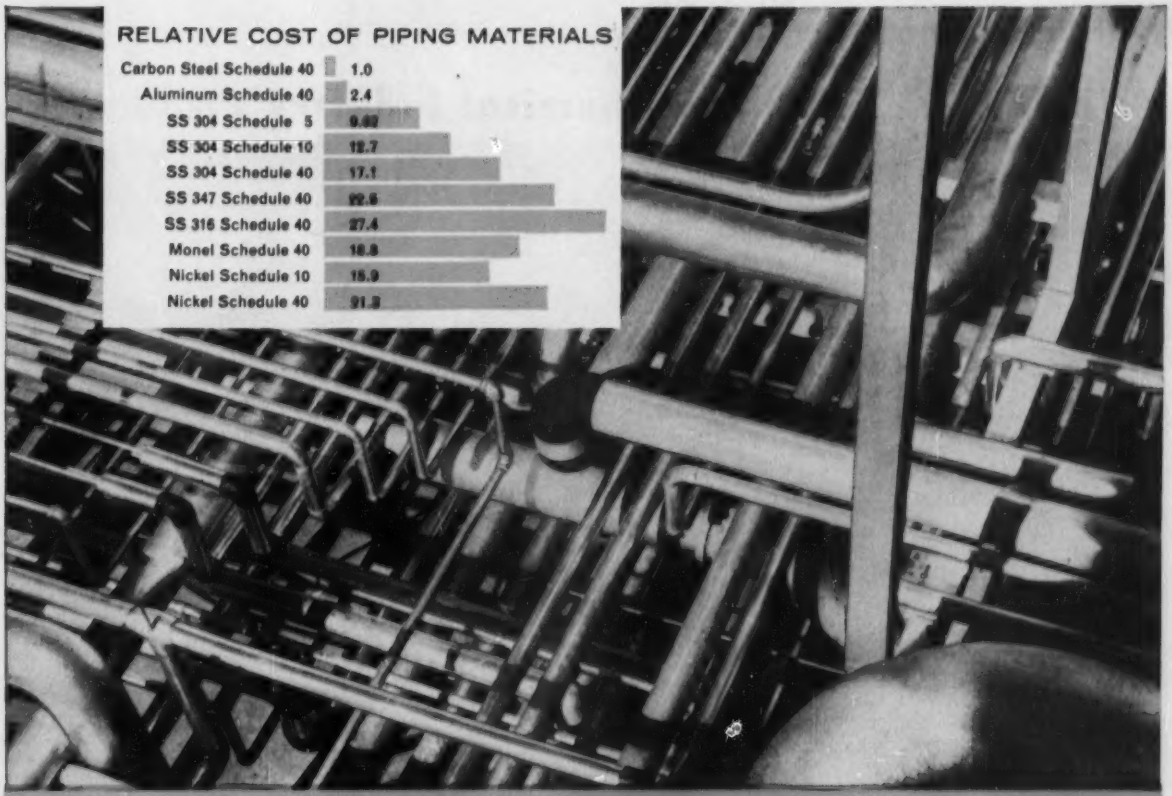
Tonrac —Single-Stage Hermetic Centrifugal Refrigerating Machines have few moving parts, install on single level. Completely self-contained.

American Blower products serve industry

- Air Conditioning, Heating, Ventilating Equipment
- Mechanical Draft Equipment
- Industrial Fans and Blowers
- Centrifugal Compressors
- Gyrol Fluid Drives
- Dust Collectors
- Refrigerating Machines

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American-Standard

AMERICAN BLOWER


RELATIVE COST OF PIPING MATERIALS
Carbon Steel Schedule 40 1.0
Aluminum Schedule 40 2.4
SS 304 Schedule 5
SS 304 Schedule 10 12.7
SS 304 Schedule 40 17.1
SS 347 Schedule 40
SS 316 Schedule 40 27.4
Monel Schedule 40
Nickel Schedule 10 15.9
Nickel Schedule 40

Corrosion Resistant

REYNOLDS ALUMINUM PROCESS PIPE

. . . the pipe that lowers costs

Many of the largest chemical and petroleum processors use a lot of aluminum pipe. They call it the most economical corrosion resistant piping product available.

That's important. Aluminum resists corrosive effects of chemicals like hydrogen peroxide, nitrogen solutions, many acids, alcohols, foods . . . and petroleum products like sweet and sour crudes, raw or refined gases, kerosene, gasoline, naphthas.

And aluminum pipe possesses other advantages. Light weight and easy weldability make for low-cost installation . . . it's nonsparking—assures safety . . . smooth inner surface reduces friction.

Standard Aluminum Fittings are available from leading manufacturers. For more information on how you can save with Aluminum Process Pipe, consult the nearest Reynolds Office listed under "Aluminum" in classified telephone directories, or write to *Reynolds Metals Company, P.O. Box 1800-CJ, Louisville 1, Kentucky.*

Write for new brochure "Reynolds Aluminum Process Pipe"

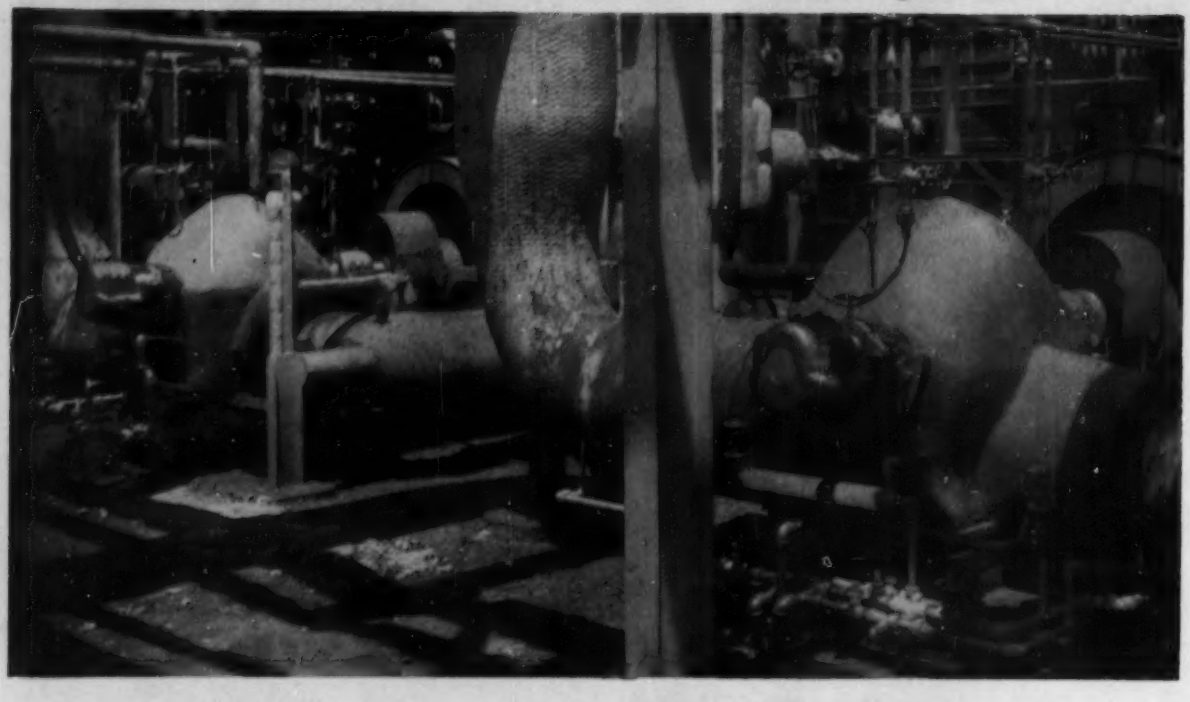
REYNOLDS NEW DUPLEX TUBE for steam traced piping. It does away with cost of external steam jackets or steam tracer tubes—the steam line is part of the aluminum pipe. Saves labor costs, material costs, insulation costs.

The Finest Products Made with Aluminum are made with REYNOLDS ALUMINUM

See "FRONTIER", Reynolds exciting dramatic series, Sundays, NBC-TV

Allis-Chalmers

PUMPS Solve a Chemical Industry Problem



All-Stainless-Steel Pumps Handle Hot Corrosive Liquids

Manufactured on duty-specifications from the customer, these Allis-Chalmers Type SG stainless steel pumps are successfully handling a highly corrosive mixture of carbonate, urea, oil, and water at 260 F.

This is another example of the way Allis-Chalmers serves the chemical industry with a wide range of types of pumps in all sizes. These versatile, high efficiency Allis-Chalmers pumps are available in many special materials to meet specific application requirements.

For full information on how Allis-Chalmers can help you reduce costs, contact your local Allis-Chalmers district office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

You Get **MORE** when you Get ALLIS-CHALMERS

You can benefit from Allis-Chalmers years of experience in pump manufacturing for all industries. The design and engineering skill resulting from this experience is at your service — you get special construction pumps that give top performance and low operating costs.

Allis-Chalmers industry-experienced engineers will help you select exactly the Allis-Chalmers pump to meet your needs, and Allis-Chalmers can furnish a complete pump unit—pump, motor, and control.

A-4983

ALLIS-CHALMERS

"What genius invested our deposits in 6 tons of rust?"

The one expense the controller can't control is unchecked corrosion!

Corrosion's just a lot of rot to an aggravated stockholder!

Who tripped up the Chairman of the Board with a corroded beam?

Who chained the Executive Vice President to his desk with a lot of corroded metal?

Who keeps boring in the Traffic Manager with corroded grates?

What's that corroded flue doing in the Treasurer's office?

"That'll be $10 for the order and 25¢ for the corrosion!"

Alerted by Firestone, management is joining your battle against corrosion

The menace of corrosion and its tragic waste have now been thrust into the consciousness of executives on every level of management.

The sound counselling, pressed upon management by technical men for years, has been featured in a challenging series of advertisements over the Firestone Exon signature. It has alerted top-management to the effect of corrosion on every job and function of industry.

This campaign has made the case and eased the way for technical men. Technologists who have long known the power of PVC to stop corrosion cold are now getting the green light.

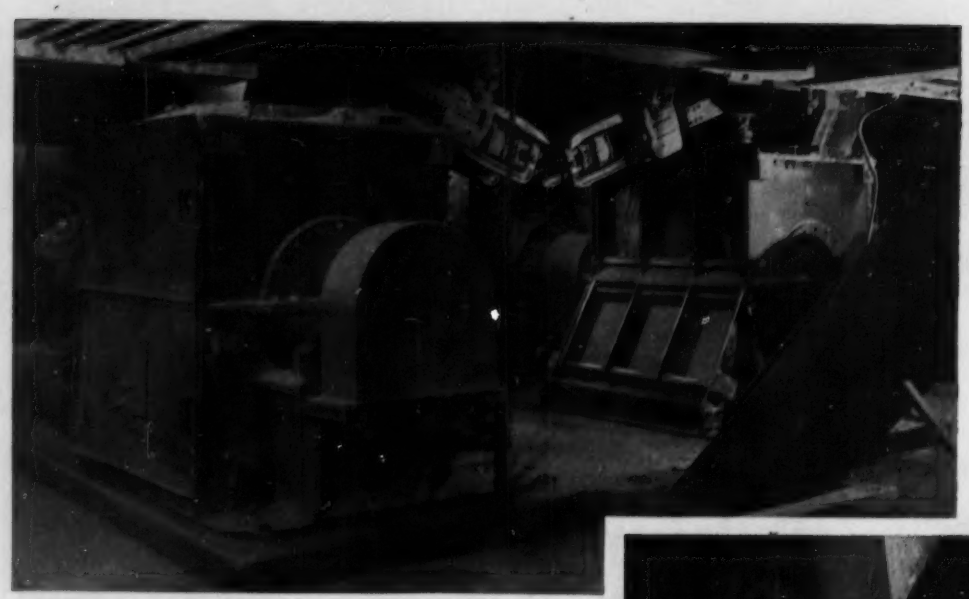
It's entirely fitting that Firestone Exon resins should lead in publicizing the technologist's war on corrosion. Firestone Exon has been campaigning against corrosion for many years.

This expanding line has proved itself in such diverse applications as self-supporting structures, dip and spray coatings, tank liners, pipes and fittings, valves and paints.

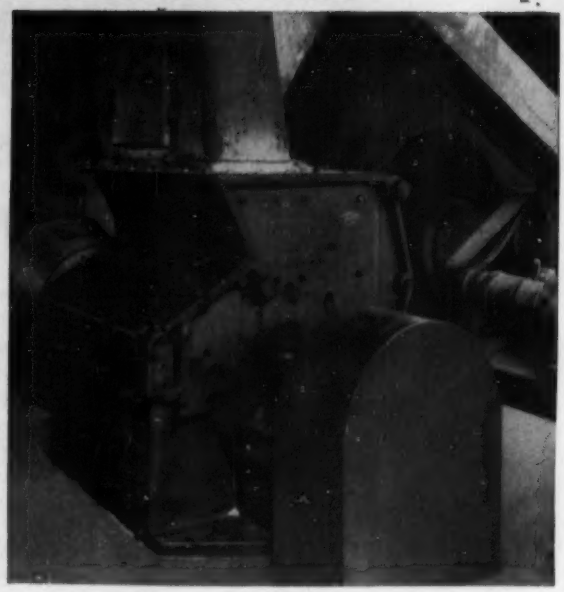
Whatever corrosives you use, whatever equipment you must protect, drop a note to Firestone today.

Firestone

CHEMICAL SALES DIVISION • Firestone Plastics Co., Dept. 628K, Pottstown, Pa. • A Division of the Firestone Tire and Rubber Co.



Pictured at left and below are Jeffrey Swing Hammer Pulverizers—a popular type crusher in the chemical field. The units at left are fed by Jeffrey vibrating feeders. Jeffrey makes a complete line of auxiliary equipment to handle feed to crushers and dispose of material being discharged from them.



For reduction of every conceivable material

JEFFREY CRUSHERS AND PULVERIZERS

WHETHER the job involves moderate or heavy duty—small or large capacities—there is a Jeffrey crusher exactly suited to produce the right size product in your plant.

Hundreds of Jeffrey crushers and pulverizers daily are successfully reducing scores of different materials in the chemical and allied industries.

Chances are Jeffrey has encountered your crushing problem before and solved it. We have the most extensive test data file maintained by any crusher manufacturer. Or we can run tests on new materials in our laboratory at no cost or obligation to you.

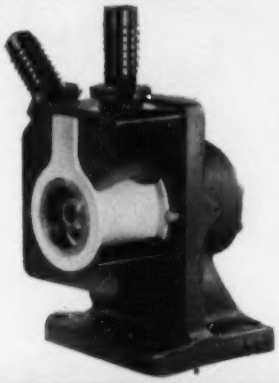
Jeffrey engineers will gladly advise you on your crushing needs. Write to The Jeffrey Manufacturing Company, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

CORPORATION BRIEFS

KEL-F LINERS FOR VANTON PUMPS



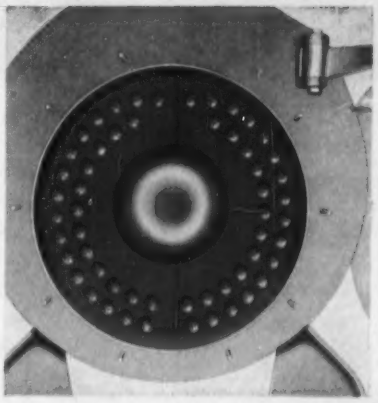
Years of testing has finally resulted in a Kel-F liner for the corrosion resistant Vanton "flex-i-liner" pump. Since the pump design eliminates stuffing boxes, shaft seals, gaskets and check valves, the only surfaces in contact with the corrosive being pumped are the liner and the housing. The addition of Kel-F to the long list of rubbers and plastics now available for liners makes the pump suitable for handling such media as fuming nitric and other strong oxidizing acids, mineral acids, alkalies, aliphatic solvents and hydraulic fluids.

Details on request.

STAINLESS STEEL RETARDERS

By creating a fiery cyclone inside the firetube of the Cyclotherm Generator, unequalled heat transfer efficiency is achieved. Known as Cyclotherm Cyclonic Combustion the new principle delivers a guaranteed 80% heat transfer in two passes and drops maintenance costs as. much as 50%.

Cooper Alloy stainless steel retarders, cast in ACI-HH heat resistant alloy, break up the gas into swirling streams, helping to produce additional heat transfer with maintenance-free reliability.

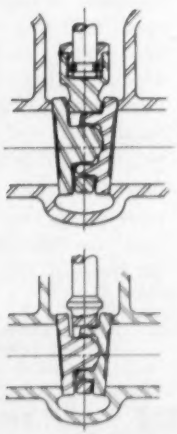


For the complete facts write to our Newscast Editor or direct your request to our Foundry Engineering Division.

CORED SIGMA BLADE

This 1500 lb. stainless steel sigma blade not only has to be corrosion resistant and dimensionally accurate but a 1½" cored hole, centrally located with respect to the various cross sections, is required throughout its length.

The full story behind this difficult casting job is told in Cooper Alloy AKH #4. A note on your company letterhead will bring it by return mail.



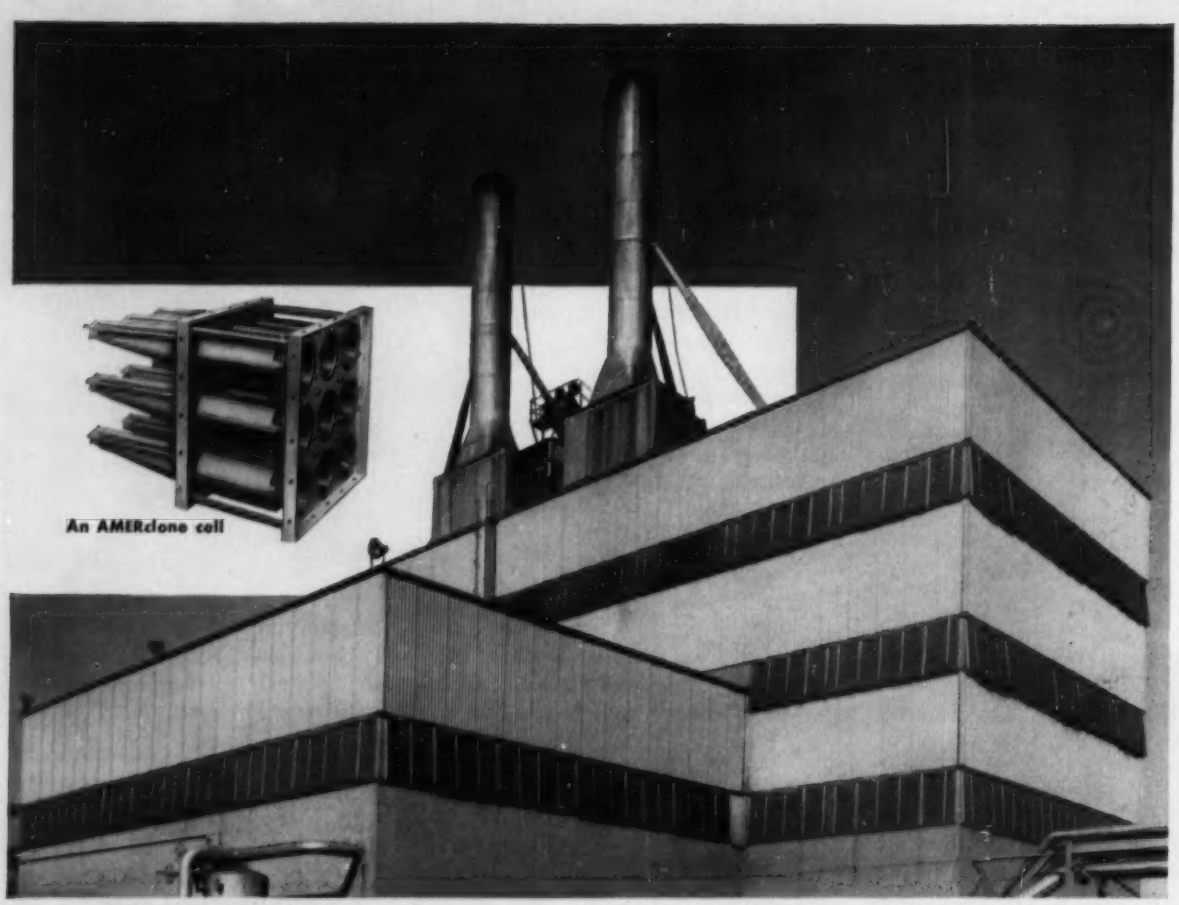
GATE VALVE DISCS

Cooper Alloy valves are normally furnished with ball and socket rotating type discs because this type of construction has been proven best for use in stainless steel. It not only lessens the tendency to gall but it is far easier to maintain and can be repaired in the field, if necessary.

Design factors of stainless steel valves are discussed in detail in the February issue of Newscast. If you would like an extra copy for your files, or if your original one went astray, drop us a note and we'll gladly send you one.

COOPER ALLOY
CORPORATION • HILLSIDE, N. J.

Divisions:
FOUNDRY PRODUCTS DIVISION · VALVE & FITTING DIVISION · VANTON PUMP & EQUIPMENT CORP
STAINLESS ENGINEERING AND MACHINE WORKS DIVISION · AIRCRAFT PRODUCTS DIVISION



An AMERclone cell

Both of the boilers at this Southern foundry were in operation when this photograph was taken. Note absence of any visible stack effluent.

AMERClone

traps 5 TONS of fly ash DAILY!

Atmospheric Nuisance Eliminated by AAF Dust Control

Boiler fly ash that formerly "went up in smoke" (only to reappear on parking lots and the surrounding neighborhood) has disappeared from the scene at this Southern foundry. An AMERclone system on each of two boilers puts this menace in its place—in the dump, where it can do no harm.

AMERclone does the job, thoroughly . . . operates at 92% efficiency *at all times,* even though boiler room requirements fluctuate as much as 30% in any 24-hour period. High collection efficiency and maintained efficiency are just two of the dollars-and-cents advantages of AMERclone. This dry centrifugal requires less space than comparable units because each 20" x 20" cell (see inset in photograph) has a rating of 3,000 cfm! And the abrasive fly ash has little or no effect on AMERclone's tough, thick-wall gray iron castings.

Don't let a few tons of dust per day stand between you and better working conditions, better community relations. Get all the facts on AMERclone. Call your local AAF representative or write direct for Bulletin 291.

AAF Dust Control Equipment

Illinois Steam Heating Specialties

AAF Herman Nelson

American Air Filter

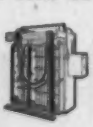
COMPANY, INC.

326 Central Avenue, Louisville 8, Kentucky

American Air Filter of Canada, Ltd., Montreal, P. Q.

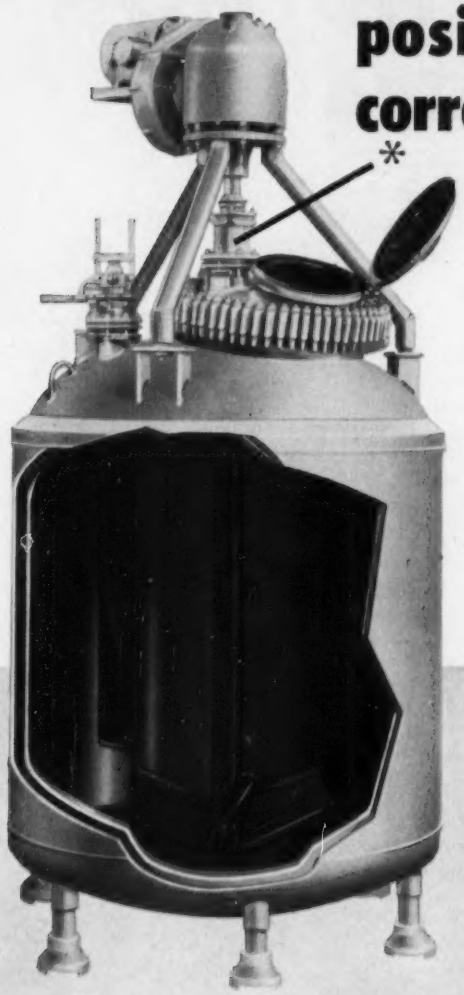
BETTER AIR IS OUR BUSINESS

Air Filters and Precipitators



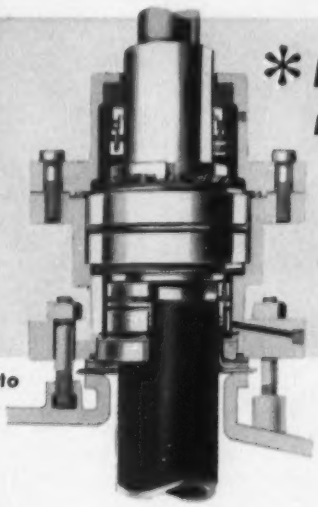
Herman Nelson Industrial Heaters

Glascote glass-lined reactors give you more years of positive protection against corrosion and contamination



• In corrosive processes, you'll find Glascote's glass-lined heavy-duty reactors provide extra years of productive, trouble-free service. And product purity is assured — ever free of metallic contamination because Glascote's highly chemical-resistant, acid-alkali glass offers great versatility of products to be processed. Glascote also gives you non-stick glass for polymer production, such as polyvinyl chloride, polyvinyl acetate and synthetic rubber. (*Glass-lined* storage vessels are also offered for both types of processing.)

Glascote can meet your specifications for large, heavy-duty reactors. Complete line is equipped with exclusive leak-proof mechanical seal, agitator and baffle . . . in capacities up to 4000 gallons and larger. Internal and jacket pressures to meet your specifications.



* Exclusive rotary mechanical seal

Glascote's exclusive rotary, mechanical seal design provides two major advantages to users of glass-lined equipment requiring either high pressure or vacuum. (1) Eliminates leakage under pressure (toxic or explosive conditions), and reduces maintenance. (2) Permits efficient use of higher operating pressures and prevents contamination of vessel contents.

Outstanding features include glass-coated gland insert, glass-coated agitator shaft, and Teflon packing.

Our standard one year guarantee continues to apply to all Glascote glass-lined products.

Glascote®
PRODUCTS, INC.

Sales offices or agents located in
New York • Philadelphia • Union, N. J. • Chicago • Cleveland
Dayton • Houston • Los Angeles
Export Sales: A. O. Smith Corp., International Division, Milwaukee 1, Wis.

Ask the representative who calls on you for all the facts about Glascote products — reactors, storage tanks, columns, conical rotary dryer-blenders, receivers, condensers and accessory products. Or, if you prefer, write direct. Glascote Products, Inc., Cleveland 17, a subsidiary of A. O. Smith Corporation.

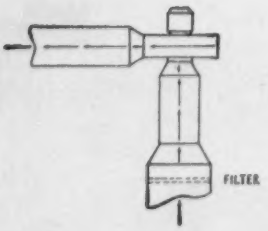
A subsidiary of A.O.Smith Corporation

World's largest manufacturer of glass-lined steel products

4 WAYS TO "CONDITION" YOUR PLANT AIR WITH "BUFFALO" UNITS

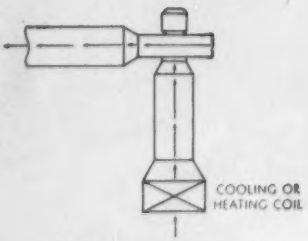
1. AIR MOVEMENT

Air movement may be all the "air conditioning" you need. It cools, carries off excessive moisture, fumes, dust and stale air. "Buffalo" Type BL Limit-Load Ventilating Fans, Axial Flow Fans and Heavy Duty Propeller Fans are creating favorable air conditions in many entire plants by: (a) blowing in fresh filtered air as in the diagram at right, or (b) exhausting undesirable air outside or into recovery units. Write for Bulletins F-100, 3533-EF and FM-1234.



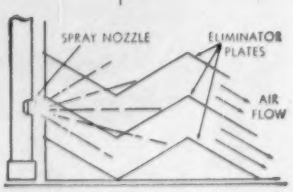
2. COOLING OR HEATING

For more temperature control than simple air circulation affords, air is cooled or heated by drawing it thru extended surface coils, then distributed by fan and duct, as shown at right. "Buffalo" ECC Evaporative Condensers are also widely used in refrigeration systems for their compact size, efficient performance and freedom from troubles. For heating and ventilating, "Buffalo" Unit heaters combine "Buffalo" Fans with heating coils, plus filter boxes, if desired.



3. AIR WASHING

Air washing provides a higher degree of cleaning than simple filtering. It also cools and humidifies. "Buffalo" Air Washers were among the first used by industry over fifty years ago, and are today almost a standard for reliability. Sketch at right shows how air passes thru banks of sprays and wetted eliminator plates, on which dust impinges and is collected in a tank under the unit. Write for Bulletin 3142-E.



4. COMBINATIONS OF ALL THREE

"Buffalo" PC Air Conditioning Cabinets are compact units for providing any or all functions of air conditioning, automatically controlled, if desired. Sturdy all-over construction, "Buffalo" Fans and Pumps — the "Buffalo" "Q" Factor* — give you bonus performance in any "Buffalo" Fan or Air Conditioning Unit you buy. CALL IN YOUR NEARBY "BUFFALO" ENGINEERING REPRESENTATIVE for competent advice on any air problem you may have. He's a factory and field trained Graduate Engineer, and he's backed by our entire home plant staff with 78 years of air handling experience.

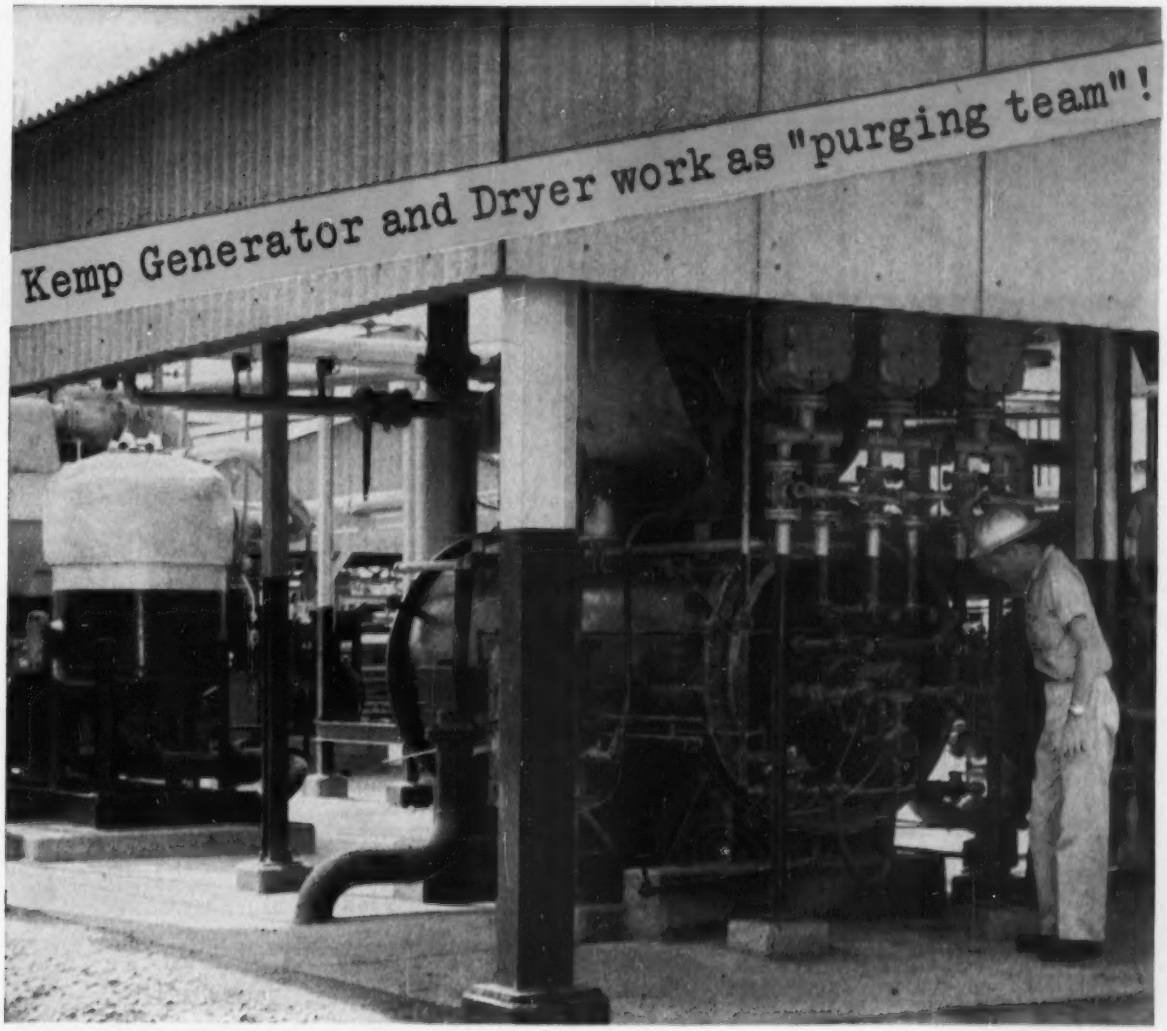
**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING



Gulf Oil Reports: *Pipe line purging problems solved by Kemp Gas Generator and Kemp Dryer*

At Gulf Oil's Port Arthur, Texas refinery, dry inert gas is required in the Ethylene Plant for purging pipe lines, tanks and vessels.

Kemp Units selected to do the job

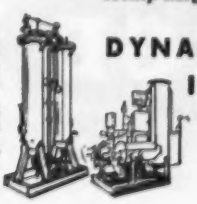
To insure a constant supply of gas—sufficiently dry and free of oil vapors—Gulf installed both a Kemp Inert Gas Generator and a Kemp Convection Type Dryer. The units work as a "purging team"...the Kemp Generator produces 30,000 SCFH of inert gas which is compressed and passed through a Kemp Pre-filter to remove all moisture prior to entering the gas receiver. The result is an efficient, easily controlled source of dry inert gas at all times.

Kemp can solve your problem too

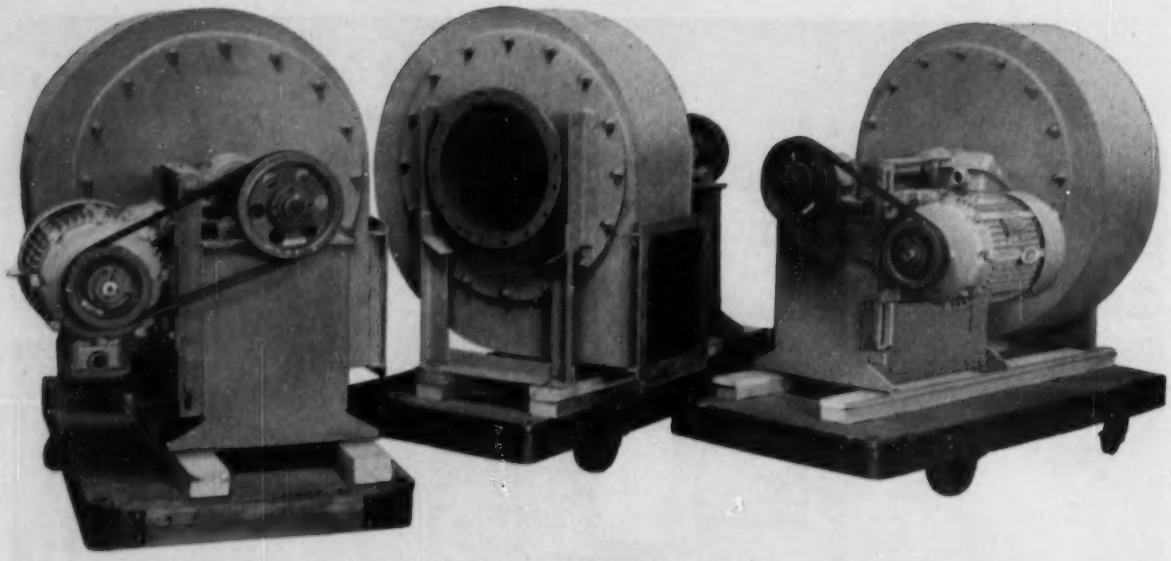
Whether your needs involve dry gases, inert gases—or both, Kemp can help you to the most profitable solution. Kemp Inert Gas Generators automatically deliver clean, controlled atmospheres at specific analysis, without fluctuation—regardless of demands. A variety of Kemp Dryers are designed to dry air, gases or liquids to sub-zero dew points and are available with manual, semi-automatic or fully automatic tower reactivation. In addition, Kemp will specify the proper desiccant for the job.

For complete facts and technical information on Kemp Inert Gas Generators and Kemp Dryers, write today to: The C. M. Kemp Mfg. Co., 405 East Oliver St., Baltimore 2, Maryland.

KEMP OF BALTIMORE



DYNAMIC DRYERS
INERT GAS GENERATORS
CARBURETORS • BURNERS • FIRE CHECKS
METAL MELTING UNITS • SINGEING EQUIPMENT



EXHAUSTING CORROSIVE FUMES

no problem for Clarage rubber-lined fans

Clarage's distinctively heavy-duty construction, plus the added advantage of special coatings, add up to far longer service life. Important savings for you!

The Clarage fans above are now serving as leach tank exhausters, handling fumes from a concentrated brine solution containing up to 5% hydrochloric acid. In this case, all interior fan parts are protected by a layer of rubber vulcanized to the metal. For other extra-severe applications Clarage fans can be treated with other special coatings, lead lined, or built of special construction.

If you're seeking fans that have what it takes — in every respect — call us in. CLARAGE FAN CO., Kalamazoo, Michigan.

Send for Bulletin 702-A

CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

THE STONE & WEBSTER RIPPLE TRAY*

A Notable Development for the Process Industries

BELOW:
Ease of installation is a plus factor for Stone & Webster Ripple Trays.

The unique RIPPLE TRAY, developed and designed by Stone & Webster Engineering Corporation, brings new concepts of economy and efficiency to fractionation.

The high capacity and simplicity of construction of RIPPLE TRAYS have effected major savings in first cost over conventional bubble cap trays. Full tower cross section is utilized for active contact of liquid and vapor. No downcomers are required.

Because of their unusual self-cleaning feature, downtime for maintenance of RIPPLE TRAY-equipped fractionation units is reduced to a minimum.

Efficiency maintained over a wide operating range makes RIPPLE TRAYS adaptable to practically every type of service.

Commercial performance has established their acceptance in the process industries.

Write or call us for information as to how our broad experience in the process field can help you.

*Trade-Mark

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY of STONE & WEBSTER, INC.

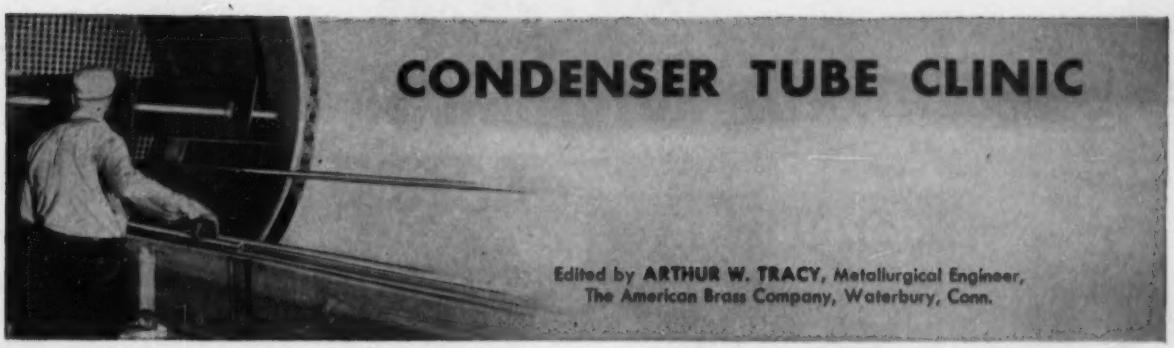
New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Seattle Toronto

MANY FINE SURFACES REFLECT THE USE OF PFIZER CITRIC, GLUCONIC AND TARTARIC ACIDS—Pfizer Citrates, Gluconates and Tartrates contribute to brightness like you see above. Whether it be through electroplating, cleaning or polishing, these Pfizer organic acids offer many advantages to metal finishers. One big advantage is **NON-TOXICITY**—greater safety for personnel in materials handling. Another advantage is mildness—so necessary in household and specialized industrial cleaners and polishes. Write for *Technical Bulletin 61* which describes in detail the many outstanding uses for **PFIZER ORGANIC ACIDS** in metal finishing.

Manufacturing Chemists for Over 100 Years

Pfizer

CHAS. PFIZER & CO., INC.
Chemical Sales Division
630 Flushing Ave., Brooklyn 6, N. Y.
Branch Offices: Chicago, Ill., San Francisco, Calif., Vernon, Calif.; Atlanta, Ga.; Dallas, Texas



CONDENSER TUBE CLINIC

Edited by **ARTHUR W. TRACY**, Metallurgical Engineer,
The American Brass Company, Waterbury, Conn.

Choose the right alloy for your condenser tubes

LONG condenser tube life depends on the proper choice of alloy as well as conditions of operation.

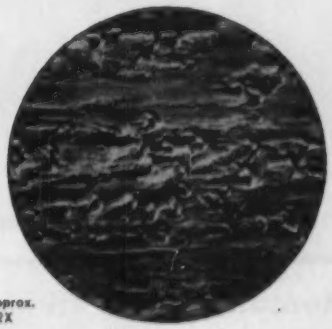
Fresh inland cooling water normally does not cause corrosion problems; either ANACONDA Arsenical Admiralty-439 or ANACONDA Phosphorized Arsenical Copper-108 tubes will give long service. ANACONDA Ambronze-421 tubes have been found more durable for river waters polluted with acid coal-mine drainage.

Sea water is usually more corrosive than fresh water. Clean sea water flowing turbulently, especially when air bubbles are present, causes inlet-end impingement pitting. Lowering the velocity, with subsequent smoother water flow, will solve this problem; but such a solution is not always economically feasible. ANACONDA Ambraloy-927 tubes are definitely more resistant to impingement corrosion than are admiralty metal tubes. Where water velocities are relatively high, ANACONDA Cupro Nickel, 10%-755 tubes can be expected to give even better service. ANACONDA Cupro Nickel, 30%-702 tubes are considered for the highest water velocities normally encountered in exhaust condensers.

Sea water in harbors and at river inlets is often polluted with decomposing organic matter which may settle in condenser tubes and cause deposit pitting. Hydrogen sulfide, a product of the decomposition, is also an important factor in corrosion by polluted waters because poorly protective scales containing metallic sulfides are formed. Chlorinating polluted waters is helpful in preventing deposit attack. Frequent removal of debris by brushing is an important factor in increasing tube life. Ambraloy-927 tubes generally give long service handling polluted sea water. In some cases, either Cupro Nickel, 10%-755 or Cupro Nickel, 30%-702 have served best because they are more resistant to deposit pitting.

Approx. 5.2X

DEPOSIT PITTING in uninhibited Admiralty Metal tube from a tidewater power station condenser. In this case a deposit of paper pulp is believed to have shielded a small area, forming an oxygen-concentration cell. The shielded area—low in oxygen content—is anodic and corrodes. Surrounding areas in contact with the solution high in oxygen form the cathode. Since the potential between the two areas is quite small, deposit pitting is usually a slow process.



Approx. 3.2X

IMPINGEMENT PITTING in an Admiralty Metal tube from the main condenser of an oil tanker. Excessively high water velocity caused turbulence, which carries away metal ions so that a protective film cannot form. An ion-concentration cell is formed, with the low-ion impinged area anodic; the areas where streamline, undisturbed flow persists, being cathodic. Air bubbles, water velocity, hydrostatic pressure drops in the tube, and alloy content, are all factors in this problem.

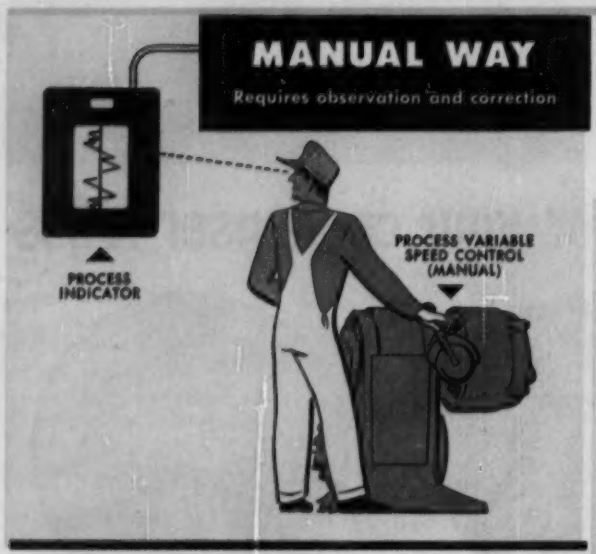
Some ANACONDA Condenser Tube alloys especially resistant to pitting, and their nominal compositions

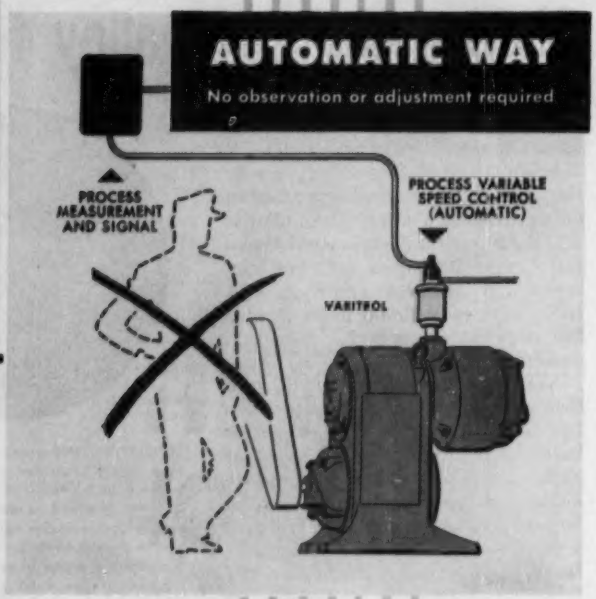
	Arsenical Admiralty -439	Ambraloy -927	Ambronze -421	Cupro Nickel, 10%-755	Cupro Nickel, 30%-702
Copper, %	71	77	88	88.35	68.90
Nickel, %	—	—	—	10	30
Zinc, %	27.96	20.96	10	—	—
Aluminum, %	—	2	—	—	—
Tin, %	1	—	2	—	—
Arsenic, %	0.04	0.04	—	—	—
Iron, %	—	—	—	1.25	0.50
Manganese, %	—	—	—	0.40	0.60

TECHNICAL ASSISTANCE—Your tube problem may require special consideration and analysis. We are always ready to help with such problems and advise in the selection of the right alloy to give the best service. Write for the new edition of our Publication B-2 on "Anaconda Tubes and Plates for Condensers and Heat Exchangers." The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 5677

ANACONDA®
Tubes and Plates for Condensers and Heat Exchangers

HOW VARITROL AUTOMATIC SPEED CONTROL saves Manpower





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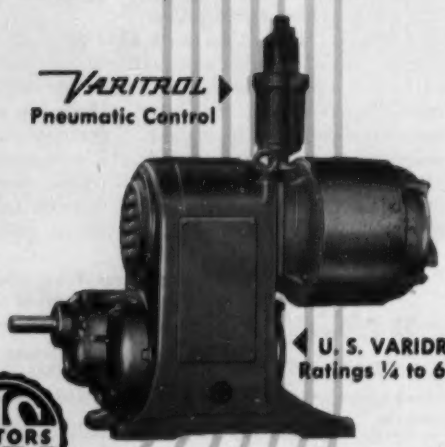

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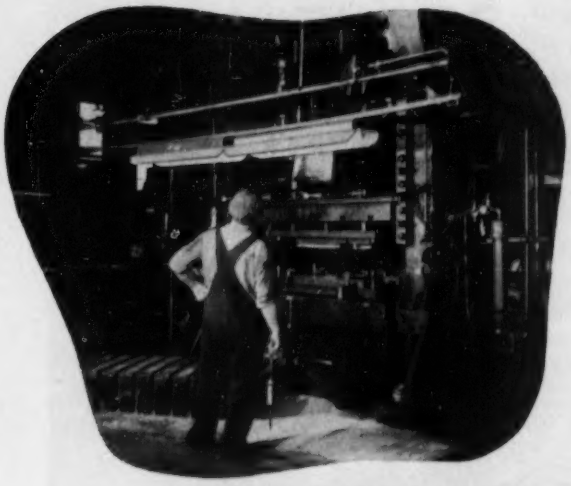
when you stop "hand feeding" hungry bearings...and change lubrication methods from

Backward to Forward!



ALEMITE PORTABLE POWER GUN

saves 23.9 man-hours for every 100 pounds of lubricant

...saves right down the line!

- A 400-pound barrel of lubricant—any type—arrives at plant oil room. It's sealed, fresh, "refinery-clean."

- An Alemite Power Transfer Pump is inserted in drum. Lubricant stays sealed against dirt, grit, contamination.

- In just 60 seconds a portable power gun is filled with lubricant that is still as fresh as when it left the refinery. No mess—no waste!

- Alemite Portable Power Gun is ready to roll anywhere in the plant . . . to service hundreds of bearings with clean, safe lubricant!

Are you lubricating hundreds of bearings with ordinary hand gun equipment that's best suited to service only a *couple of dozen bearings?*

An ordinary hand gun can be emptied in a few minutes. But an Alemite Power Gun gives positive, fast, safe lubrication to hundreds of bearings *without a single re-fill!* This difference means a saving of 23.9 *man-hours* on every 100 pounds of lubricant used. Because lubricants are always kept "refinery-fresh," machines get better protection, have less breakdowns. You make important *savings in machine-hours* . . . increase production, cut maintenance costs!

An Alemite Portable Power Gun eliminates wasteful spillage . . . makes housekeeping easier, less expensive . . . reduces product spoilage. Air or electrically operated models for all types of lubricants. There's a type and size pump for your plant. Mail coupon at right for the full story about Alemite savings!

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Ask anyone in industry

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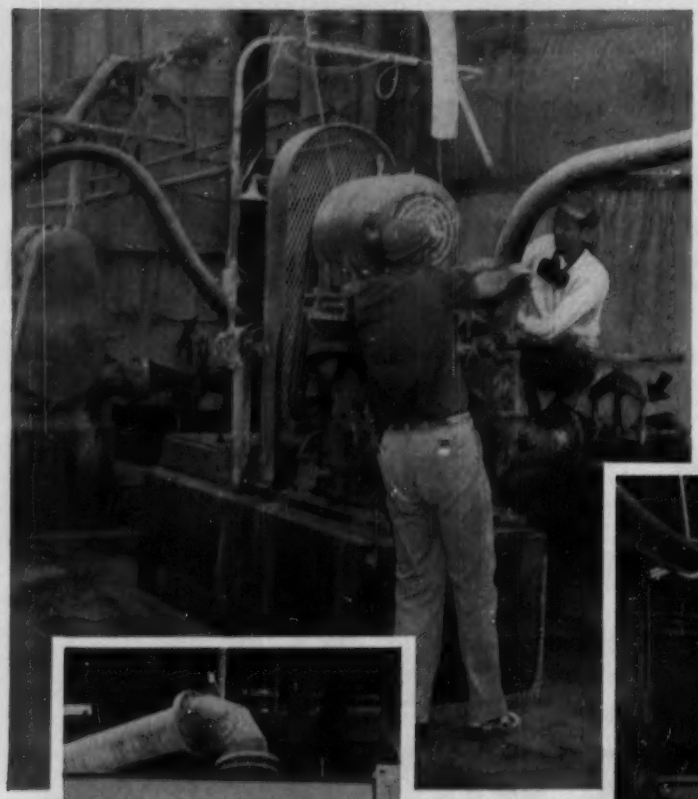
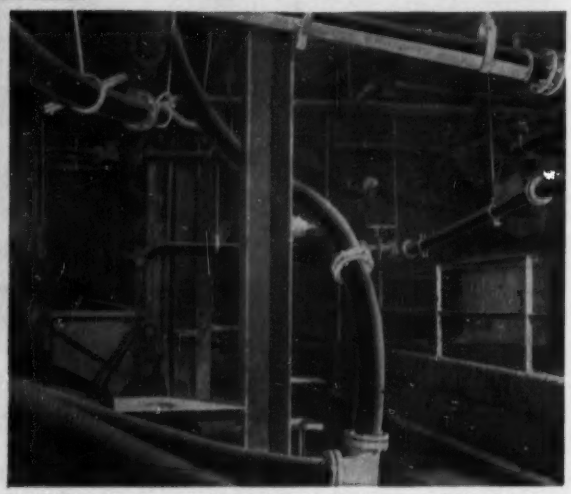
A Product of STEWART-WARNER CORPORATION

"WE DON'T HAVE TIME TO CODDLE PIPING OR VALVES— SO WE USE U. S. RUBBER PRODUCTS . . ."

says production official of phosphate chemical plant



The U. S. Rubber Pilot pinch valve (arrow) connects to the big tank in the background (with U. S. Giant Acid Hose at right) and serves to control the flow of acid, gypsum and solids to the digestor tank, from the pump.



U. S. Rubber Pilot pipe, dominates this picture of slurry tanks for first stage filters. Note also U. S. Acid Hose.

U. S. Expansion Joint (arrow) connecting a leak-proof fitting to a vibrating pump in phosphate plant.

This large plant in Florida operates 24 hours a day, 7 days a week, making fertilizer and animal food supplements. Corrosive acids, (phosphoric and sulphuric) flow freely, and without damage, through U. S. Rubber Giant® Acid Hose. "Metal hose would clog, corrode and crack," says the production official of the plant. "We also use U. S. Rubber Pilot® Pinch Valves—because they don't clog, freeze or need to be babied like metal valves."

This plant also uses U. S. Expansion Joints and U. S. Pilot Pipe and U. S. Giant Acid Hose to control, pipe, pump and convey the flowing semi-solid acids. All of these products are easy to install, easy to clean and maintain. The plant's officials have found that U. S. Rubber products are unmatched in facilitating production and in reducing maintenance and equipment charges. They have standardized on "U. S." products. It will pay you to take any and all corrosion problems to a "U. S." specialist. Get in touch with any of our 28 District Sales Offices, or write Mechanical Goods Division, United States Rubber, Rockefeller Center, New York 20, N. Y.

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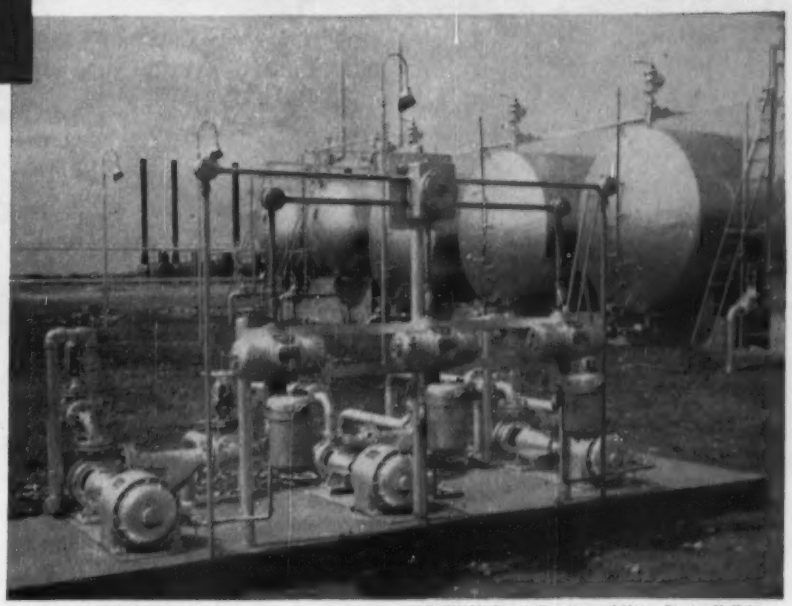

Photo courtesy Oil & Gas Journal

APPLETON Circuit Breaker and Motor Starter Unilets on tank car loading pump motors in field processing plant.

More TOP-QUALITY features!

- First to be U.L. Approved for banked circuit breaker grouping
- Combinations meet U.L. requirements through approval of components
- No shut-downs while entering motor starter of a combination
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The biggest advancement in Explosion-Proof design in years! The design, construction and performance of APPLETON Circuit Breaker and Motor Starter Unilets give you maximum safety and unparalleled ease of wiring, installation and maintenance. You'll discover initial and long term savings plus many exclusive APPLETON features, not found in any other enclosure.

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Tilting Disc Check Valve

There, in a nutshell, is the story of a Chapman Tilting Disc Check Valve . . . quick as a cat, quiet as a mouse. It's designed that way. It's built that way . . . for fast, sure, quiet action. Or, in other words, it's yours for best performance at lowest long-range operating costs.

With a Chapman Tilting Disc Check Valve, there's no noise, no vibration, no fluttering. There's no banging or slamming with damage to system or valve. There's no scraping or wearing of disc and seat. Your head loss or flow resistance is kept at a minimum.

To put it briefly, with a Chapman Tilting Disc Check Valve, there's little or no maintenance even under severe operating conditions.

For Chapman Tilting Disc Check Valves in iron and steel . . . valves for handling fluids or gases under a wide range of pressures . . . valves for replacement or new piping systems . . . just check our Catalog 30-A. It's yours for the asking. Send for it now.

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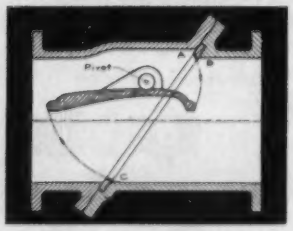
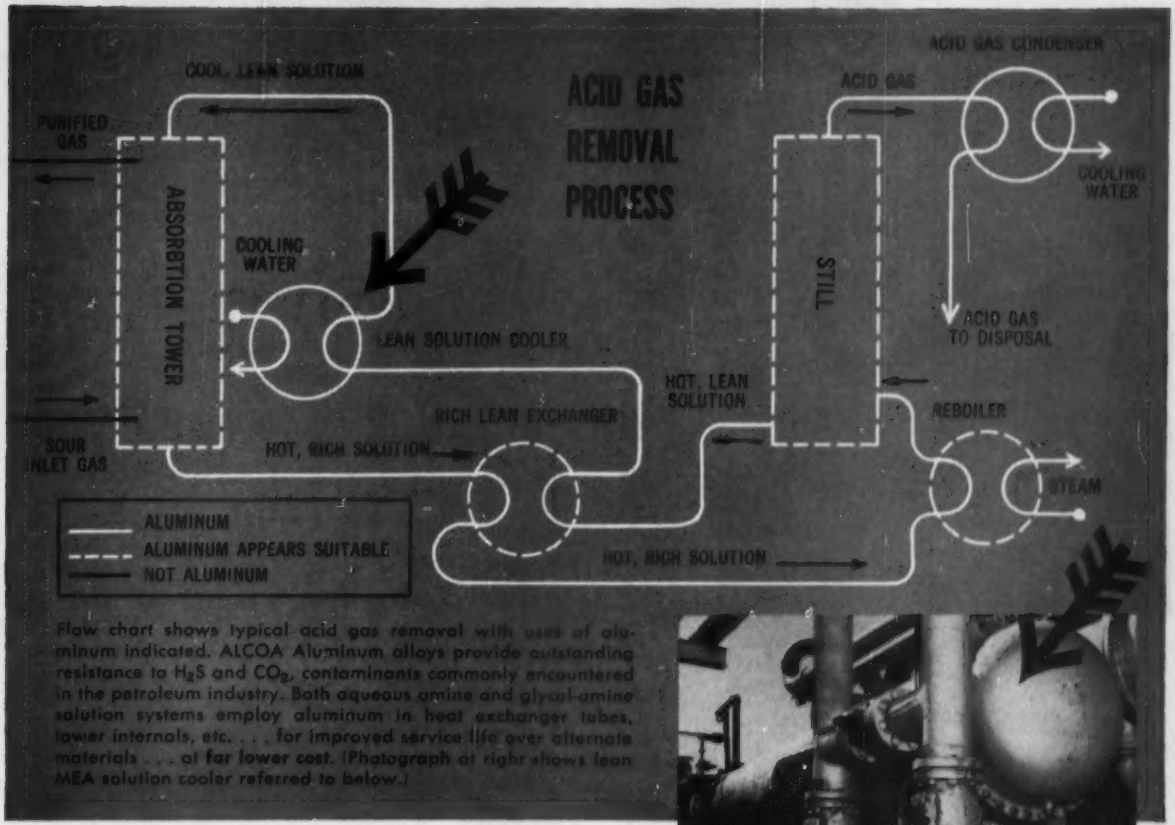
Never a Flutter, Never a Slam!

Designed and Built for Quiet Efficient Operation

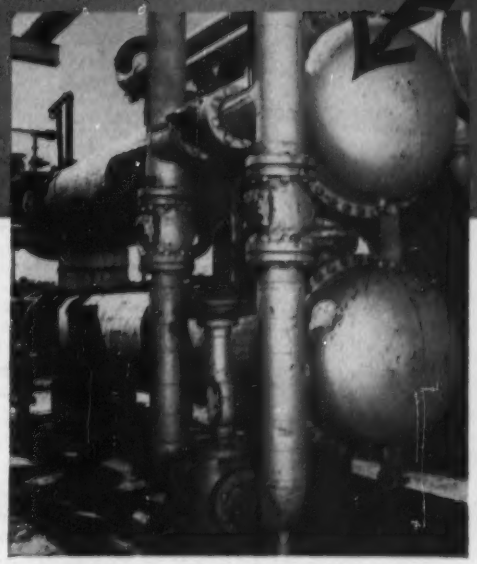


In open position, specially designed "airfoil" disc balances perfectly. No vibration. No flutter. When flow subsides, disc drops quickly and quietly to a tight closed position. No jarring. No slamming. No damage to system or valve. Note enlarged area around disc to insure low flow resistance.

Major oil company proves corrosion resistance of **ALCOA ALUMINUM** Heat Exchanger Tubes



Flow chart shows typical acid gas removal with uses of aluminum indicated. ALCOA Aluminum alloys provide outstanding resistance to H_2S and CO_2, contaminants commonly encountered in the petroleum industry. Both aqueous amine and glycol-amine solution systems employ aluminum in heat exchanger tubes, tower internals, etc. . . . for improved service life over alternate materials . . . at far lower cost. (Photograph at right shows lean MEA solution cooler referred to below.)



Over 750 days' exposure to corrosive gas contaminants has proved to a major oil company the superior resistance of ALCOA Alclad Heat Exchanger Tubes. Used in the lean MEA solution cooler of a Girbotol Gas Treater, the tubes are exposed to a solution carrying 10 grains of hydrogen sulfide per gallon at the rate of 350 gallons per minute. After more than two years of service, the aluminum tubes are virtually unaffected.

Such service records have proved time and again that ALCOA Alclad Aluminum Tubes withstand corrosion best. Materials like hydrogen sulfide and carbon dioxide—normally corrosive to most metals—are not corrosive to aluminum. That means longer service life, less maintenance—to reduce process operating costs.

What's more, ALCOA Aluminum Heat Exchanger Tubes in the common sizes cost far less than seamless tubes of other common materials . . . one-half as much as Admiralty brass . . . one-third to one-fifth as much as cupronickel or stainless steel. It will pay *you* to use the handy coupon today for complete details.

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ALUMINUM COMPANY OF AMERICA

ALUMINUM COMPANY OF AMERICA
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Please send me your free 24-page booklet, Alcoa Aluminum Heat Exchanger Tubes

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Company _____

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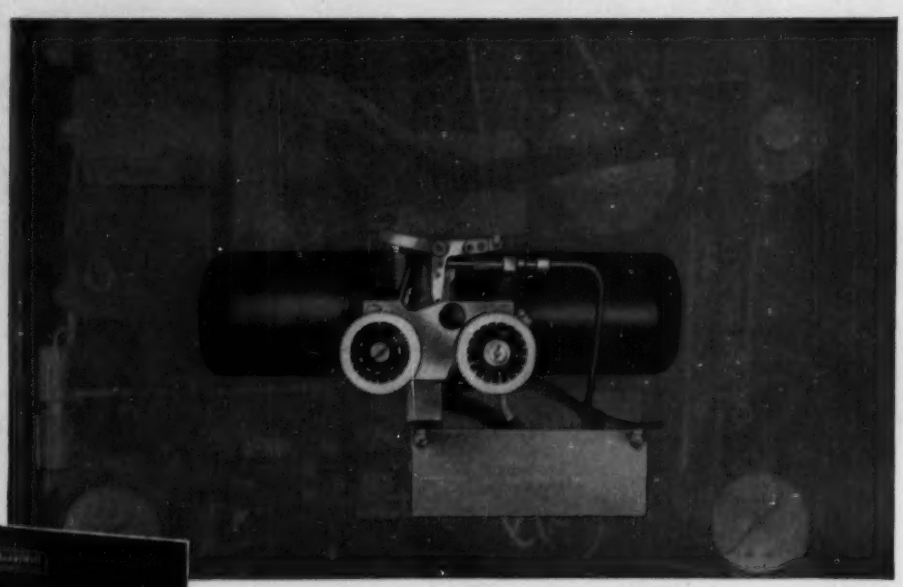

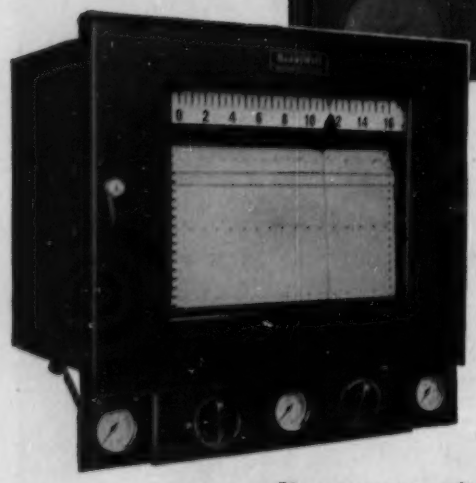

this instrument makes your tough control jobs easy

ElectroniK Air-O-Line controller measures with ±0.2% accuracy... provides fast, sensitive control

If your process can't stand any offset, if you insist on reliable performance and hairline accuracy . . . this is the controller for you. Sensitive to changes as small as 3 parts in 10,000, this controller holds the measured process variable right where it belongs.

The *ElectroniK Air-O-Line* controller measures and controls temperature, pressure, flow, pH —*any* variable that can be changed into an electrical signal. By standardizing on this controller for your most critical processes, you reduce your maintenance burden. The same components are used in both strip and circular chart models.

Maintenance? Hardly any with the *ElectroniK Air-O-Line* controller. Dirt, dust, and dampness are sealed out. Vibration won't affect operation. The three main components of the *ElectroniK* instrument—amplifier, converter, and balancing motor—can be easily replaced if necessary.

This controller has proved itself in thousands of tough applications. It's the product of pioneering experience in electronic instrumentation . . . made by the world's largest instrument manufacturer . . . backed by the world's largest instrument service organization.

Call in your local Honeywell sales engineer for a discussion of your application. He's as near as your phone.

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ElectroniK Air-O-Line FEATURES

- Pneumatic proportional-plus-reset control
- Proportional band widths adjustable from 1 to over 200%
- Automatic reset rates from 0 to 14 repeats per minute
- Rate action unit easily added where needed
- Factory-calibrated within limits of ±0.2%
- Hermetically sealed converter
- Totally enclosed balancing motor
- Sealed liquid-filled *Air-O-Line* unit with single, clog-free restriction
- "Building block" construction for easy interchangeability of components

MINNEAPOLIS **Honeywell**

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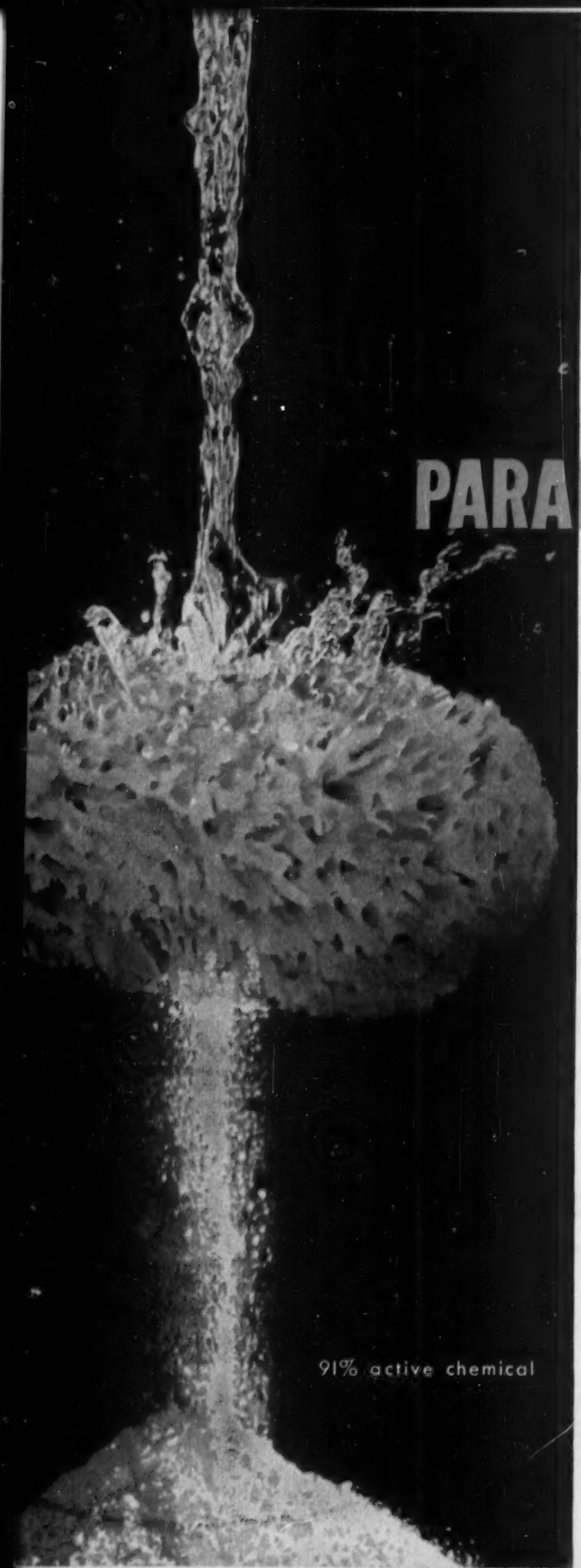

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You can reduce capital investment by using Celanese Paraformaldehyde. No need for heated storage tanks or large storage area. Same output from smaller kettles; lower steam, electricity and cooling costs.

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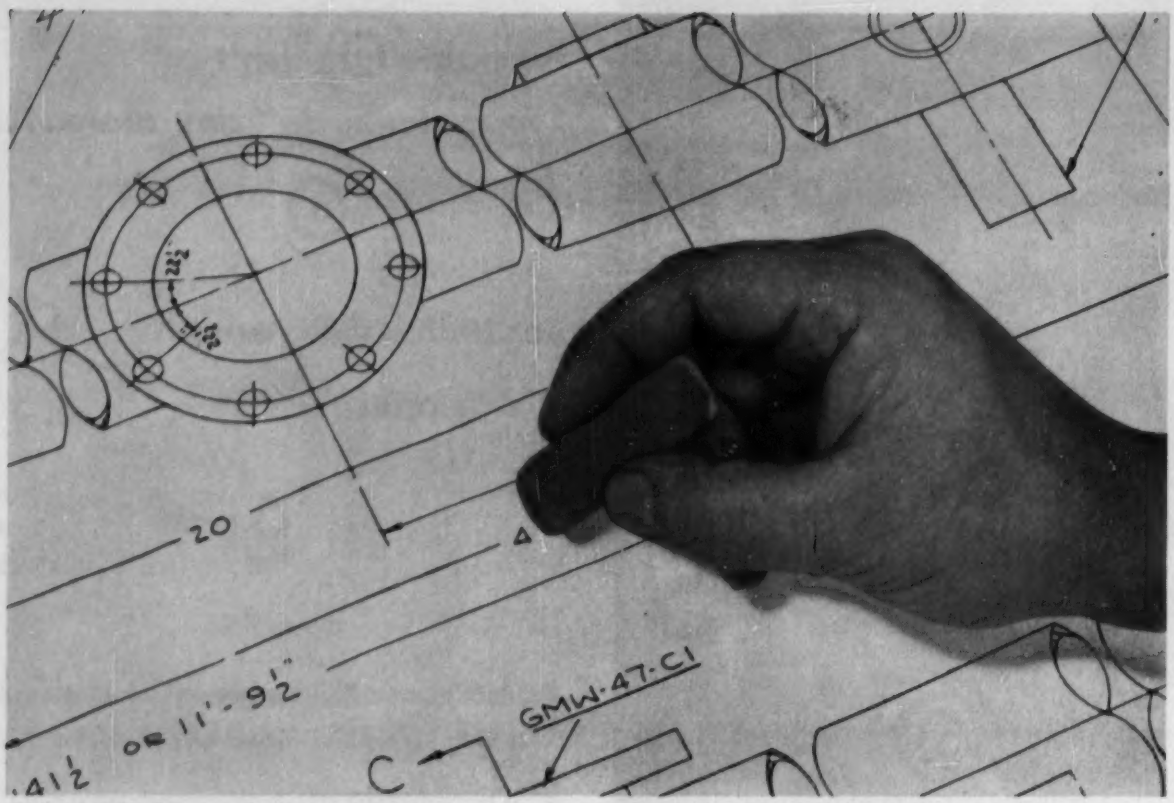

Photographic lines on a Kodagraph Autopositive Paper Translucent intermediate can be quickly removed with ordinary eraser.

To simplify design changes

How can you make changes in a drawing—but still keep the original design intact—without costly retracing? In thousands of drafting rooms they follow this short cut: *Reproduce the drawing on Kodagraph Autopositive Paper Translucent.*

This gives you a positive photographic intermediate *directly*, without a negative step or darkroom processing. Remove the unwanted detail from this print with a moistened pencil eraser. Add the new design with pencil or ink—and presto! *You have a new print-making master* on high-quality vellum-type paper, which will turn out sharp, legible blueprints or direct-process prints at fast machine speeds.

This is just another example of the way you'll save with low-cost Kodagraph Materials, which you, or your local blueprinter, can process quickly.

EASTMAN KODAK COMPANY
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New booklet is jam-packed with valuable tips on saving drafting time, protecting drawings, getting better prints.

Kodagraph Reproduction Materials

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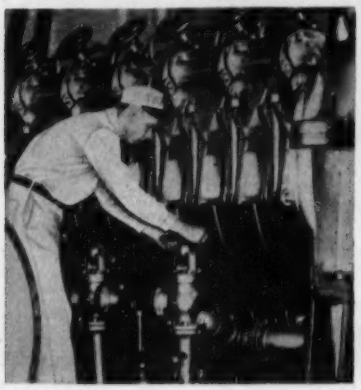
ADSORPTION IS A BASIC CHEMICAL ENGINEERING PROCESS

DARCO Digest

CHEMICALS DIVISION, ATLAS POWDER COMPANY, WILMINGTON 99, DELAWARE • Atlas Powder Company, Canada, Ltd., Brantford, Ontario, Canada

TIPS ON FILTRATION

The final step in adsorption processes using powdered activated carbon is filtration, where the carbon is removed, carrying the adsorbate with it. The objective is to produce maximum flow of filtrate free from suspended carbon.



The individual carbon particles, in a properly made powdered grade, are ground small enough to give good accessibility to the internal adsorptive area, but not so small as to cause difficulty in filtration. In making powdered grades of Darco, particles are ground so that 70% pass a 325 mesh screen, and 100% pass a 200 mesh.

Flow rate of liquid through a filter is determined by the viscosity of the material you're processing. Rates may range from 2 to 3 gallons per hour per square foot of filter area for a heavy sugar liquor to 40 gallons per hour per square foot for free flowing liquids like water.

Carbon particles usually are dispersed in the liquid as agglomerates. Any action which breaks up the agglomerates will interfere with fast, clear filtration. Excessive agitation in the treatment tank will break up the agglomerates mechanically . . . especially when you have viscous liquids which will hinder re-agglomeration of the particles. This is easy to cure: Just reduce the agitation.

Or, you may run into a phenomenon called peptizing, caused by certain surface active materials which break up the carbon agglomerates into individual particles that slip through the filter. One remedy for this situation is to use filter aid both as a pre-coat, and along with carbon; also, to avoid excessive filter pressures.

Write to us for advice on your filtration problems. Our long experience may prove valuable.

Pharmaceutical products need premium purity carbon

For purifying and decolorizing pharmaceuticals, fine chemicals and food products of many types, you require a grade of activated carbon of exceptionally high purity. The reason is evident: when *taking out* undesirable materials, you want to avoid introducing any *new* contaminants.

Darco G-60 is our premium purity grade especially manufactured for this kind of usage. Special processing gives it extremely low content of ash and solubles. Its silica and iron content are the smallest of any grade we make. And it's premium in performance, too . . . has the best filtering properties of all Darco grades and low retention . . . a property that can save you a lot of valuable product that might otherwise be lost in the filter cake.

We recommend that you consider Darco G-60 for purification of streptomycin, sulfadiazene, and other antibiotics; for organic acids such as lactic and citric; for narcotics; and for hydroquinone, dye intermediates, nylon salts and other fine chemicals.

IMAGINEERING *with activated carbon*

We've been telling you about some of the ways you can use activated carbon as an adsorbent. Carbon, however, has other talents. Because it is exposed in a large surface area, the carbon in activated carbon is an efficient reducing agent. One pound has upwards of 50 acres of effective area within its internal pore structure.

This fact leads to several useful applications. One is the removal of traces of free halogens in solution . . . for example, in water supplies. Carbon reacts with chlorine to form HCl and CO_2. Only ppm concentrations are involved, but the unpleasant taste and odor of free chlorine is effectively removed in soft drink bottling plants, breweries and numerous other industrial users of water.

Similarly, residual quantities of permanganates introduced for oxidation purposes can be removed by means of activated carbon. Potassium permanganate, for instance, is reduced by carbon to the tetravalent form, and the characteristic deep color of permanganate is eliminated due to the reduction . . . *not*, in this case, by decolorizing action of the carbon.

If you've got a tricky reduction problem, try activated carbon. You may be surprised at the results.

No matter how you do it, get word to Morton for help in solving any salt problem

The Morton Salt Company offers fast help from salt specialists—at no cost to you. You get the best possible help when we dispatch a Morton Consulting Engineer in your area to your plant. He's an expert when it comes to solving problems relating to salt—and he's backed by the services of chemists and salt scientists at Morton's ultra-modern salt research laboratory.

A Morton Consulting Engineer can help you determine which grade, or grades, of salt will do the best, most economical job in your particular operation. He can help you expand or modernize a brine installation or plan a new water softening system. Best of all, these services don't cost you a cent—and they may well save you hundreds of dollars.

Whatever your salt needs are, Morton can fill them promptly and economically. Morton produces many grades of salt for use by the chemical industry. Only Morton has nine strategically located plants to serve you. And only Morton can offer fast delivery from a bag to a trainload, at favorable prices and freight, *anywhere* in the country.

Sending distress signals from a mountain top is advisable only if you're steeped in the code of the hills. The best way to get help, of course, is to write or wire.

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INDUSTRIAL DIVISION
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Chicago 3, Illinois

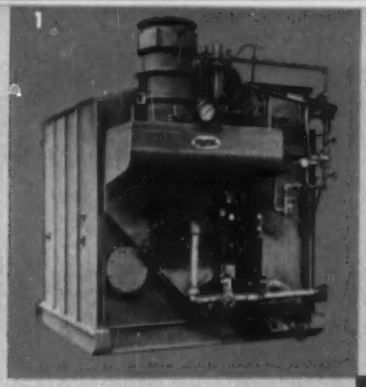
TITUSVILLE
THE TITUSVILLE IRON WORKS CO. TITUSVILLE, PA.
BOILERS Since 1860

Package Units

A Complete Selection

★ THE RIGHT TYPES
★ THE RIGHT SIZES
★ THE RIGHT BURNERS

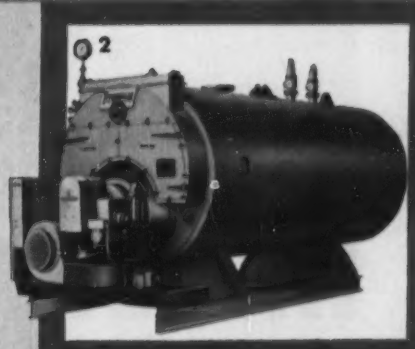
for every process power and heating need!

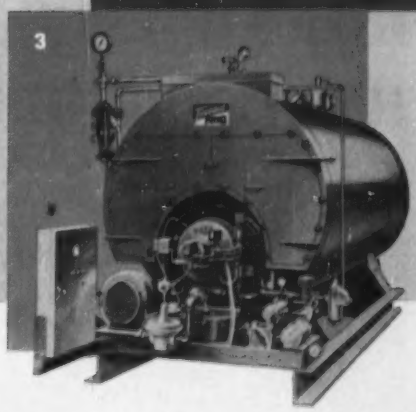


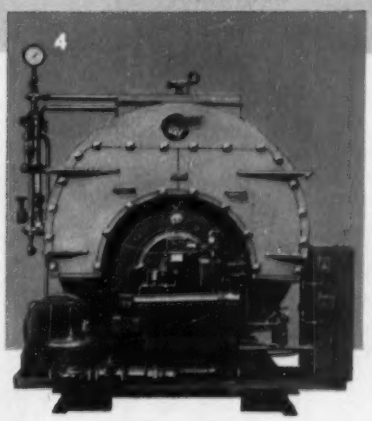
1. Titusville WTP Water Tube Steam Generator. Continuous steam capacity 7500 to 40,000 lbs per hr.

2. Titusville—Iron Fireman Boiler-Burner Unit.

3. Titusville—Petro Boiler-Burner Unit.







4. Titusville—Ray Boiler-Burner Unit.

Titusville Package Unit Boilers serve the chemical industries in a range covering all requirements, from the most complicated high pressure process and power loads to simple heating loads—smoothly, quietly, economically. All have modern automatic safety features; each is shop-assembled, shipped complete with all components installed, easily handled by lifting or skidding, and ready to go when field service connections are made. For prompt advice on the boiler type, size and burner combination precisely meeting your needs, write us!

THE Titusville IRON WORKS COMPANY

TITUSVILLE, PENNSYLVANIA

Manufacturers of A Complete Line of Boilers for Every Heating and Power Requirement

Offices in Principal Cities

Plants at Titusville, Pa. and Warren, Pa.

A Division of Struthers Wells *Corporation*

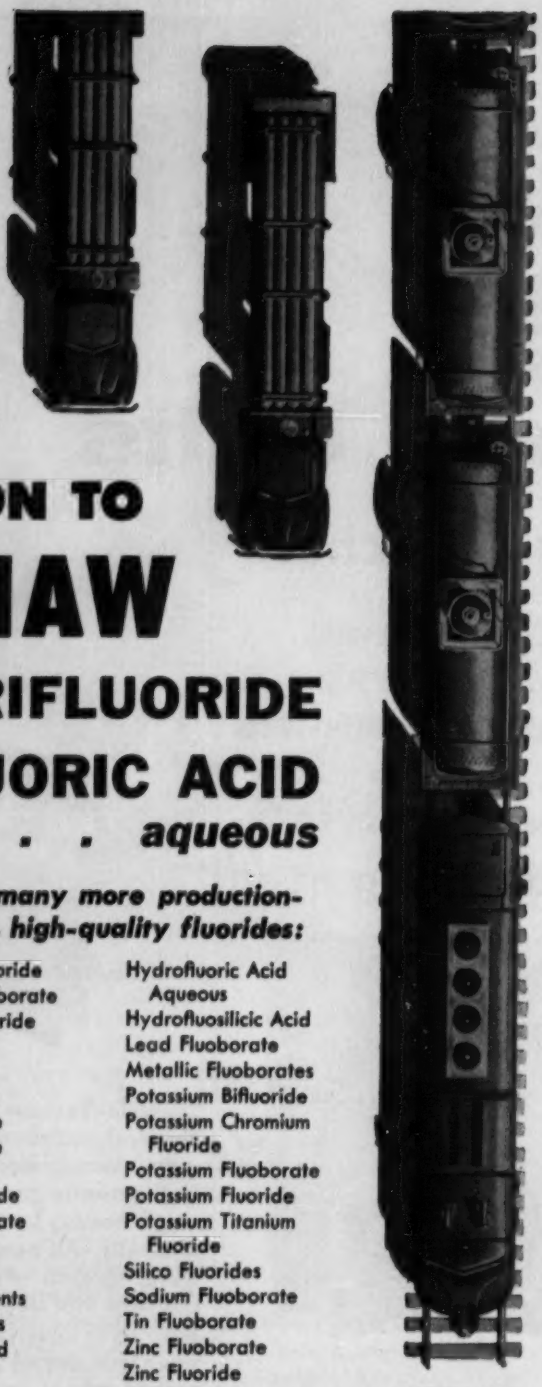
STRUTHERS WELLS PRODUCTS:

BOILER DIVISION
BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

FORGE DIVISION
Crankshafts . . . . Hydraulic Cylinders Pressure Vessels . . . . Shafting . . . . Straightening and Back-up Rolls

PROCESSING EQUIPMENT DIVISION
Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

MACHINERY DIVISION
MACHINERY for Sheet and Structural Metal Forming . . . Tangent Benders . . . Folding Machines . . . Roller Table and Tumble Die Bending Machines . . . Press Brakes . . . Punching and Notching Machines . . . Forming Dies



IN ADDITION TO HARSHAW

BORON TRIFLUORIDE
HYDROFLUORIC ACID
anhydrous . . . aqueous

Here are many more production-controlled, high-quality fluorides:

Ammonium Bifluoride
Ammonium Fluoborate
Antimony Trifluoride Sublimed
Barium Fluoride
Bismuth Fluoride
Boron Trifluoride
Boron Trifluoride Complexes
Chromium Fluoride
Copper Fluoborate
Fluoboric Acid
Fluorine Cells
Fluorinating Agents
Frosting Mixtures
Hydrofluoric Acid Anhydrous
Hydrofluoric Acid Aqueous
Hydrofluosilicic Acid
Lead Fluoborate
Metallic Fluoborates
Potassium Bifluoride
Potassium Chromium Fluoride
Potassium Fluoborate
Potassium Fluoride
Potassium Titanium Fluoride
Silico Fluorides
Sodium Fluoborate
Tin Fluoborate
Zinc Fluoborate
Zinc Fluoride

THE HARSHAW CHEMICAL CO.
1945 East 97th Street • Cleveland 6, Ohio
Chicago • Cincinnati • Cleveland • Detroit • Houston
Los Angeles • Hastings-on-Hudson, N. Y. • Philadelphia
Pittsburgh

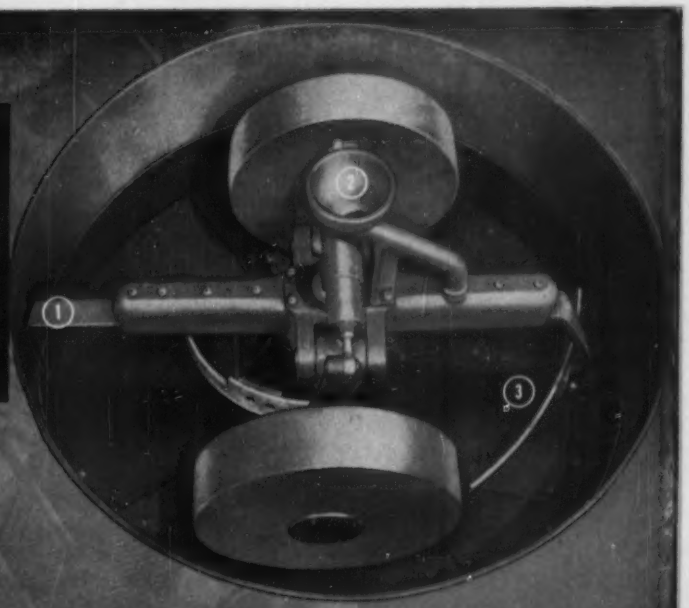
WRITE FOR
Harshaw's 40-page Book on Hydrofluoric Acid Anhydrous. It provides helpful data.

HERE'S WHY THERE'S

NO BUILD-UP PROBLEM

WITH

SIMPSON MIXED MATERIALS



Automatic, bottom discharge and self cleaning action speeds mulling and reduces mixer maintenance

The photo above offers proof of why the Simpson Mix-Muller is preferred by operators who want a *thorough* blend of dry, wetted or plastic materials.

Take a good look at it—you can *see* why this simple, efficient design can assure these *welcome* mixing features:

A CLEAN MIX — (1) Crib scraper and plow action *eliminate* build up of material, guard against contamination of mix and assure formula control. Muller scrapers are available, too. (2) An integral funnel guides liquid additions to path of mullers to assure no waste and fast mixing.

A THOROUGH MIX — Fast efficient muller and plow action quickly disperses minute quantities of ingredients. Bottom discharge (3) is automatic, almost instantaneous.

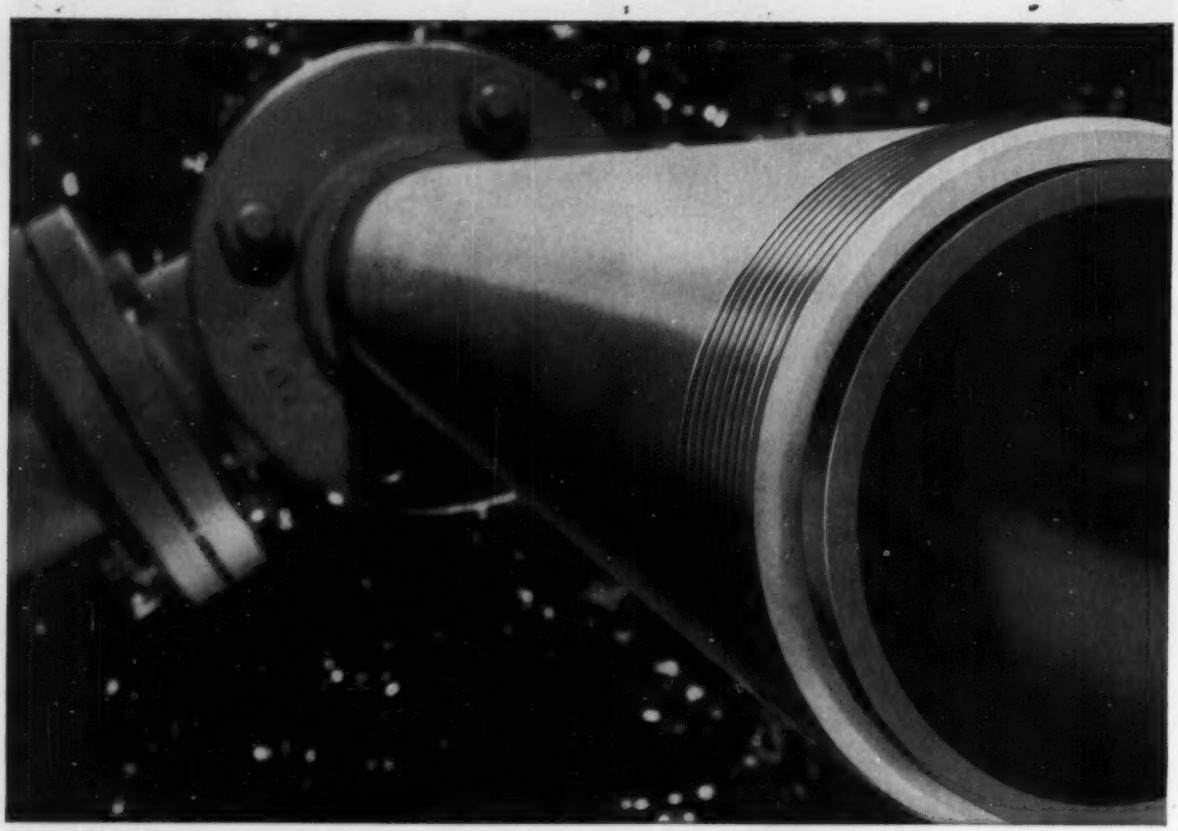
AN ECONOMICAL MIX — You use less horsepower because power is used only to mix — *not* to drive pan or power discharge. You can gain *absolute* control over character of mix. Result? A controlled mix and *an end product* faster, and at less cost.

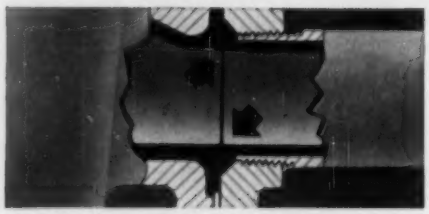
Simpson Mix Mullers are available in a range of batch capacities of 1/10 to 60 cubic ft. and are described in our new bulletin, "Mulling for the Chemical & Process Industries." Write for your copy today.

SIMPSON *MIX-MULLER*® DIVISION

NATIONAL ENGINEERING CO., 636 Machinery Hall Bldg., Chicago 6, Ill.

DOW





Saran lined pipe to saran valves. Notice the saran lining is continuous.

You can see why Saran Lined Pipe eliminates costly downtime

Corrosive liquids can't touch the strong steel pipe ... even at fittings ... it's lined continuously with thick, durable saran

Saran lined pipe, fittings and valves convey acids, alkalies and many other corrosive liquids for years with trouble-free performance. One chemical manufacturer reports a saran lined pipe installation used intermittently for ten years with no corrosion shutdowns. Similar reports came from the petroleum waste, pulp and paper, metal finishing and food processing industries.

Saran lined pipe is made of corrosion-resistant saran swaged into rigid steel pipe. Saran lined pipe, fittings and valves form snug, tight-fitting, leak-proof joints ... is available for working pressures up to 150 psi. Valves and fittings are also available in steel for working pressures to 300 psi. This modern piping is easily installed, too. It can be cut and threaded in the field with available pipe fitters' tools. Its rigidity means few supporting structures are needed. For further information on saran lined pipe, fittings and valves, send in the coupon on the left. THE DOW CHEMICAL COMPANY, Midland, Michigan.

Saran Lined Pipe Company
2415 Burdette Avenue
Ferndale, Michigan
Dept. SP628A

Please send me information on saran lined pipe, fittings and valves.

Name _____ Title _____

Company _____

Address _____

City _____ State _____

Saran Lined Pipe is Manufactured by The Dow Chemical Company, Midland, Michigan

you can depend on DOW PLASTICS

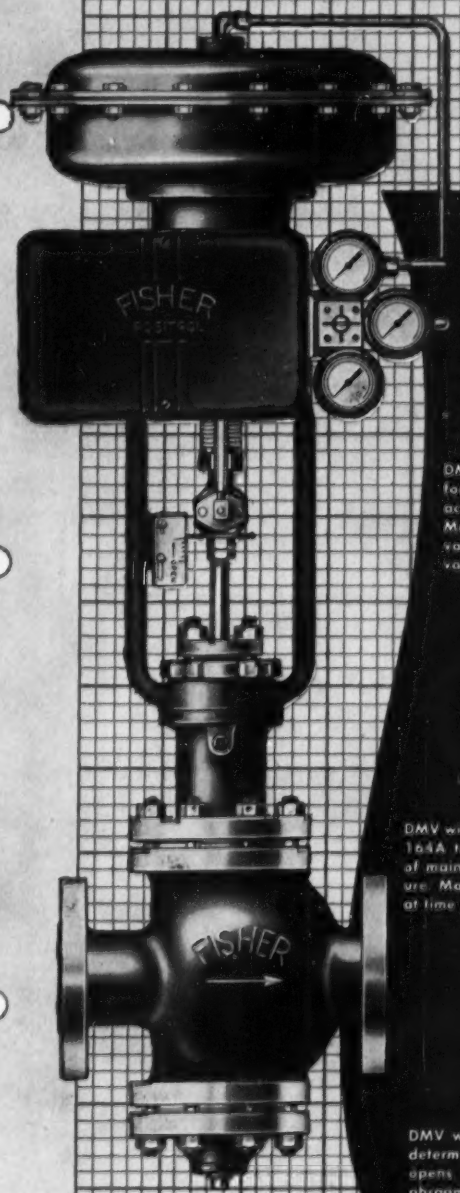
DOW

FISHER®

THE ANSWER TO YOUR

Control Problem

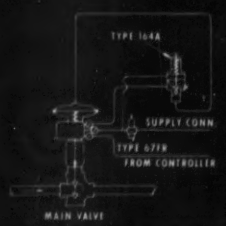
Built for your specific requirements, Fisher Diaphragm Motor Valves are manufactured to handle pressure conditions up to 30,000 pounds, for high pressure drops and are available in metals for highly corrosive service and alloys for high temperature work.



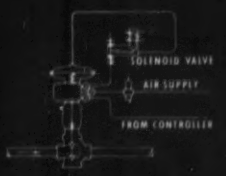
TYPICAL EXAMPLES OF FISHER DIAPHRAGM MOTOR VALVE WIDE RANGE ADAPTABILITY

DMV with Hand Jack Operator. Allows for manual operation against spring action. Limits travel of valve. Example—Maximum opening in spring opened valve. Minimum closing in spring closed valve.

DMV with Continuously Connected Handwheel. Operator can open or close valve against controller action. Can operate valve manually if operating medium fails. Can set maximum opening or minimum closing of inner valve.



DMV with Air Lock-up system using Type 164A to close air circuit to diaphragm of main valve in case of plant air failure. Main valve will be held in position at time of supply pressure failure.



DMV with Remotely Actuated Electric Solenoid Trip Out. Valve may be fully opened or closed by unloading operating pressure from diaphragm by solenoid operation. Solenoid is actuated from manual switch or an electric tie-in circuit.

DMV with Air Cut-out Feature. At predetermined pressure setting, unloader opens and bleeds pressure off diaphragm to keep main valve open. Unloader orifice is larger than controller orifice so main valve remains open. Operation restored by putting thumb over open end of unloader.

DMV with Auxiliary Controller Override. An auxiliary controller, such as temperature, placed in operating air line to diaphragm—can over-ride action of main control function by unloading diaphragm and taking over functional operation of DMV.

FISHER GOVERNOR COMPANY

MARSHALLTOWN, IOWA ● WOODSTOCK, ONTARIO

LEADS THE INDUSTRY IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

FISHER *Since 1880*

for
a New DENSITY HIGH
in
Concentrating Heat-Sensitive
Liquids

Use a Buflovak
ROTO-VAK
Concentrator

It provides these PROFIT-BUILDING features:

- High concentration of a wide variety of heat-sensitive, viscous and foamy food products and chemicals
- Sterilization combined with concentration
- Increased capacity
- Lower operating cost
- Simplicity of operation
- Ease of cleaning
- Dependable, uniform results, with original qualities of the product retained

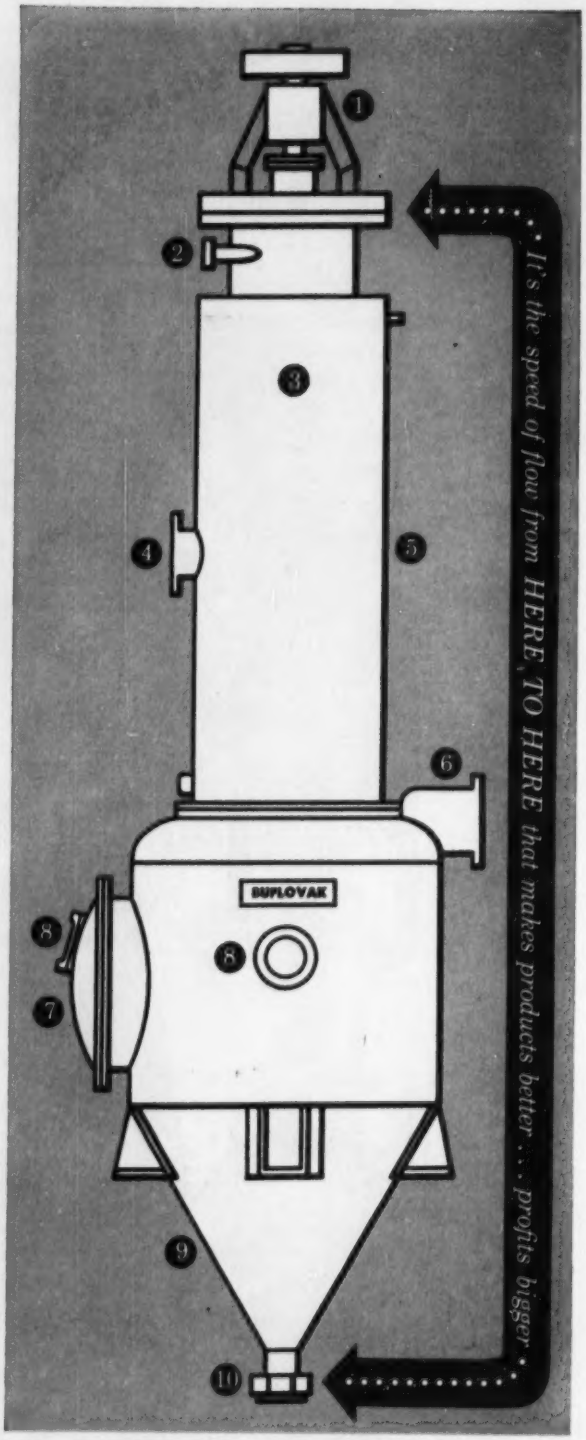
The Buflovak ROTO-VAK Concentrator employs the single pass, downflow principle, plus positive agitation. The combination gives entirely new results, with concentrations of many liquids carried to higher densities than can be satisfactorily accomplished in conventional type evaporators, retaining or improving desirable quality of the concentrated product.

The ROTO-VAK is extremely flexible, operating successfully through a wide temperature range and safely and effectively performing sterilization along with concentration.

We will be glad to test your product on a semi-plant scale with our laboratory model ROTO-VAK Concentrator in the Buflovak Research Laboratory and Testing Plant. Complete information on request.

ASK FOR BULLETIN NO. 369

50th Anniversary
BLAW-KNOX
1906-1956



(1) ROTOR DRIVE (2) PRODUCT INLET (3) INTERNAL VAPORIZATION TUBE (equipped with rotor to increase heat transfer) (4) STEAM INLET (5) EXTERIOR HEATING SECTION (6) VAPOR OUTLET (7) QUICK OPENING DOOR (for easy cleaning) (8) OBSERVATION GLASSES (9) CONE BOTTOM (10) FINISHED PRODUCT OUTLET (no recirculation)

BLAW-KNOX COMPANY

Buflovak Equipment Division, 1551 Fillmore Avenue, Buffalo 11, N. Y.

Red-hot recipe for tougher tank cars

Typical DURADOME—designed for formaldehyde service

WHEN heavy-gauge steel is formed and welded into a tank car tank . . . certain internal stresses develop which tend to weaken the metal. That is why ACF tanks are "popped into the oven" to relieve these stresses.

Each tank is scientifically heated under controlled conditions. This results in a tank of uniform strength which is ready to resist the forces of load and impact which occur during transportation.

When you're looking for the toughest tank cars ever built, look to Shippers'. We are the exclusive sales agent of ACF-DURADOME tank cars for industry. You'll find a nationwide network of Shippers' Car Line offices and repair shops ready to serve your transportation needs.

Whatever your tank car requirements may be, better talk to Shippers' . . . and get the benefits of *modern* tank car service!

SHIPPERS' CAR LINE

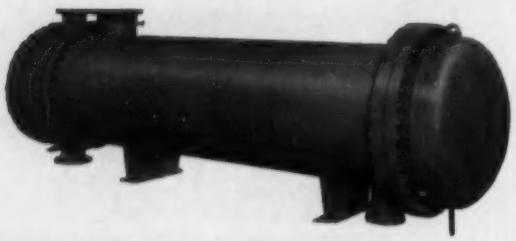
Division of ACF INDUSTRIES, Incorporated

30 Church Street, New York 7, N. Y.

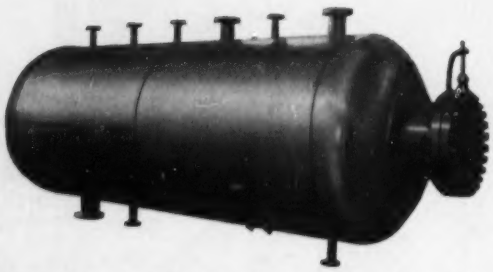
CHICAGO, ILL. • HOUSTON, TEX. • SAN FRANCISCO, CAL. • MILTON, PA. • EAST ST. LOUIS, ILL. • SMACKOVER, ARK. • TULSA, OKLA. • NORTH KANSAS CITY, MO. • RED HOUSE, W. VA.

WHITLOCK PROCESS EQUIPMENT

. . . for every processing purpose!

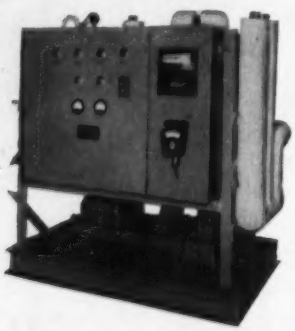


HEAT EXCHANGERS Whitlock manufactures a complete range of heat exchangers for every processing requirement. Standard designs include: Straight Tube and U-Tube, and Coil and Double Pipe types.



PRESSURE VESSELS Where engineering design is important — for special operating conditions, longer service, or lower maintenance costs — a Whitlock Engineer can help you select the right Pressure Vessel to meet your exact needs.

COILS Whitlock is fully equipped to fabricate coils of any size or material and to assemble and test them hydrostatically or by "air under water". Whether your process demands standard or special configurations, Whitlock can meet your requirements quickly and economically.



"PACKAGED" PROCESS SYSTEMS Whitlock is regularly "packaging" complete assemblies to handle typical process problems as in the case of this transfer oil heating system. Included are standard heat exchangers and vessels with complete operating controls for simple plant installation permitting immediate operation.

In addition to manufacturing standard sizes and types of Heat Exchangers, Whitlock is fully equipped to design and build specially constructed Exchangers for both high and low temperature services and for operating pressures ranging from a complete vacuum to several thousand pounds per square inch. Through long experience, Whitlock Engineers have developed special techniques for welding all standard materials as well as combinations of dissimilar metals such as aluminum to bronze and nickel to carbon steel. For complete information, write The Whitlock Manufacturing Company, 94 South Street, West Hartford 10, Connecticut. In Canada: Darling Brothers, Ltd., Montreal.

Whitlock

Designers and builders of bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers.

Introducing...

The New BS&B Type 1460 Temperature Controller

Vapor-Tension Sensing System	
Bulb Range	Recommended Working Range
0-100° F.	20-90° F.
40-140° F.	60-130° F.
40-240° F.	90-220° F.
100-350° F.	175-335° F.

Gives Positive Fluid-Flow Control Through Diaphragm Operated Valves, Based On Temperature Variations

The new BS&B Type 1460 Temperature Controller or Pilot is equipped with an external vapor-tension thermal system to actuate the power unit in the pilot.

Except for this actuating mechanism and the temperature indicator which is an integral part of it, the 1460 Controller has all of the excellent features offered in the well-known BS&B Type 1440 Control Pilot—including the ¼" supply medium reducing regulator and two pressure gauges.

This unit is especially suited for translating temperature variations to direct flow-control of fuel, or of heating or cooling medium, through diaphragm operated valves.

FEATURES

- Vapor-Tension Sensing System
- Choice of Temperature Ranges
- Built-In Temperature Indicator
- Simple Adjustment Permits Either 100% Throttling Action—Or "On-Off" Snap Action Within A Wide Limiting Range.
- Parts Interchangeability With BS&B 1440 And 1450 Pilots Reduces Maintenance Cost And Parts Inventory.

Ask your BS&B Representative for more details—or write to . . .

BS&B — ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.

Controls Division, Dept. 4-N8

7500 East 12th Street — Kansas City 26, Missouri

Wagner TRANSFORMERS...THE CHOICE OF LEADERS IN INDUSTRY

Where uninterrupted power is a must...

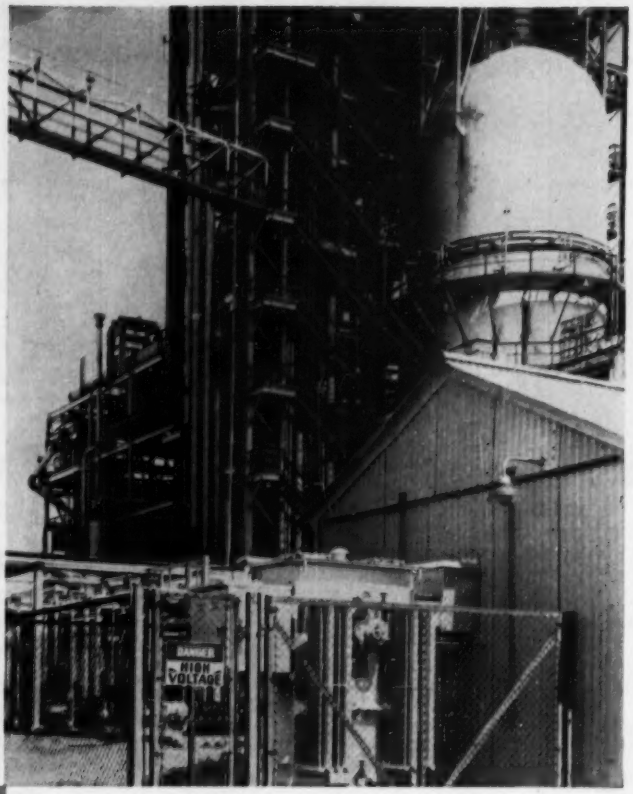
WAGNER UNIT SUBSTATION TRANSFORMERS

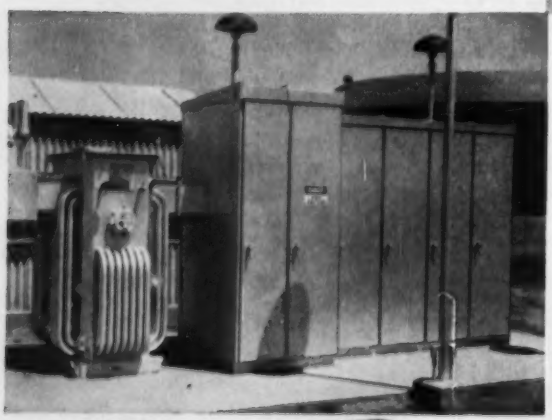
A completely dependable power supply is a vital necessity to an oil refinery. A power interruption of only a few minutes on a "cat cracker," like the one shown at the right, would completely disrupt this important processing operation and cause a shut-down of the entire refinery.

That's why you'll find Wagner Unit Substation Transformers at work at the Carter Oil Company refinery at Billings, Montana.

Wagner transformers are often found in installations where power supply failure would incur great loss because they have a reputation for complete dependability—backed by sixty-five years of transformer building experience.

Wagner Unit Substation Transformers, both liquid-filled and dry-type, are carefully designed to meet distribution requirements. Both liquid-filled and dry-type unit substation transformers are built in ratings through 2000 kva, 15 kv and below—you can choose the type and rating that exactly meets your load-center distribution requirements. Call the nearest of our 32 branch offices, or write us.





The 750 kva, 2400/4160Y to 480 volt, 60 cycle, three-phase, liquid-filled Wagner Unit Substation Transformer feeds the catalytic unit at The Carter Oil Company refinery. At left is shown a 225 kva Wagner substation transformer connected to an outdoor substation at the same refinery. Purchased and installed by The Fluor Corporation, Ltd., Engineers and Constructors for the Petroleum, Chemical and Power Industries, Los Angeles.

* * *

Write for Bulletins TU-205 and TU-214. They give full information on Wagner Unit Substation Transformers. Consult the nearest of our 32 branch offices about your next transformer installation.

Wagner Electric Corporation
EST. WE 1891

Wagner Electric Corporation
6407 Plymouth Ave., St. Louis 14, Mo., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

WT56-9

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS-AIR AND HYDRAULIC

Once...Waste
Today... **PROFITS**
via CHEMICO Sulfuric Acid Plants

Waste material, once separated and discarded during gold processing operations, is today yielding profits in uranium recovery via sulfuric acid.

The pyritic concentrates shown above, stripped of gold and uranium, serve as raw material for making sulfuric acid, which in turn is then used to recover uranium from gold processing waste.

Today, SEVEN plants of Chemico design are turning out 1100 tons of sulfuric acid per day in the Transvaal and the Orange Free State of South Africa exclusively for the recovery of uranium . . . just another example of how CHEMICO SULFURIC ACID PLANTS are being employed in making profits out of by-product industrial wastes.

CHEMICAL CONSTRUCTION CORPORATION

Designers and constructors of complete plants and facilities for the chemical and petrochemical processing industries for over 40 years

525 WEST 43RD STREET, NEW YORK 36, NEW YORK

Cable Address: Chemiconst New York • Technical Representatives: Cyanamid Products Ltd., London South African Cyanamid (Pty) Ltd., Johannesburg

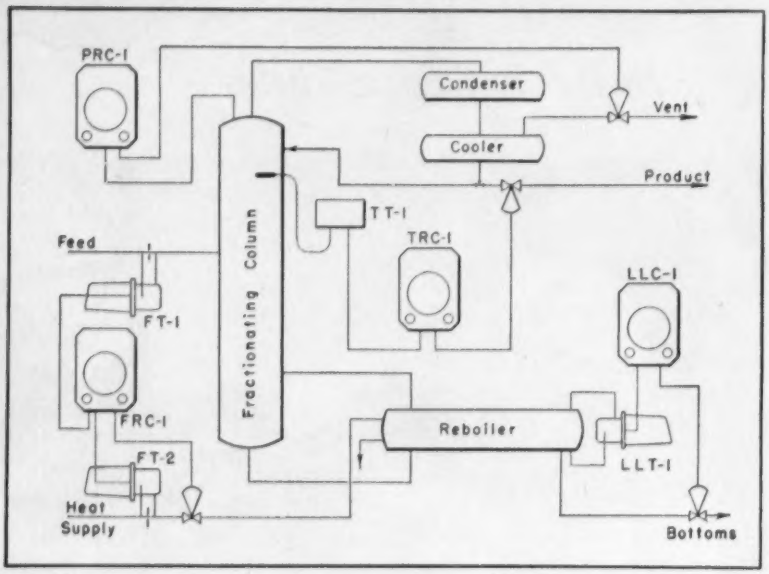
CC 117

CONTINUOUS DISTILLATION COLUMN CONTROL

One of a series of basic instrumentation recommendations for the unit operations

GEORGE E. HOWARD, Manager
Application Engineering Dept.

"Unquestionably, our reputation for successful distillation column control is based on broad experience with every type of distillation problem, and a complete line of instruments that meets every need."



PROBLEM

To operate a continuous distillation column at maximum efficiency, and at the same time produce an overhead product of the required purity.

SOLUTION

The proper application of control instruments, as illustrated, will assure that the critical process variables are continuously maintained at the best operating values.

Pressure controller PRC-1 controls pressure at the top of column by regulating the venting of non-condensibles from the condenser. Precise control of pressure is essential to good composition control.

Since the liquid and vapor phases are in equilibrium at any point in a column, and since pressure is precisely maintained, temperature is a measure of composition. Transmitter TT-1 measures the temperature at a point as near the top of the column as possible, yet at a point where equilibrium temperature is a significant measure of composition. TRC-1 therefore records composition in the column, measured as a temperature, and controls it by regulating the rate at which the reflux is returned. Thus a means is provided for continuous control over the purity of the product by controlling composition as near the top of the column as possible.

The heat supply to the reboiler is automatically controlled in relation to the feed rate so that no more heat need be used than is necessary for the required stripping.

Flow transmitter FT-1 measures the feed rate while FT-2 measures the heat supply rate. FRC-1 is a recording flow ratio controller which automatically controls the flow of the heat supply at the predetermined optimum value relative to the feed rate. Thus the column is always operated at maximum efficiency.

The liquid level in the reboiler is measured by a differential pressure transmitter LLT-1. Instrument LLC-1 indicates the reboiler level, and controls it by regulating the rate of discharging bottoms product. This accomplishes two things; first it maintains the best level for efficient use of the available heating surface in the reboiler, and second it assures that bottoms product will be discharged at a steady rate corresponding to the rate at which component separation is being accomplished in the column.

BENEFITS

1. Continuously guards product purity.

2. Keeps cost of heat supply to a minimum.

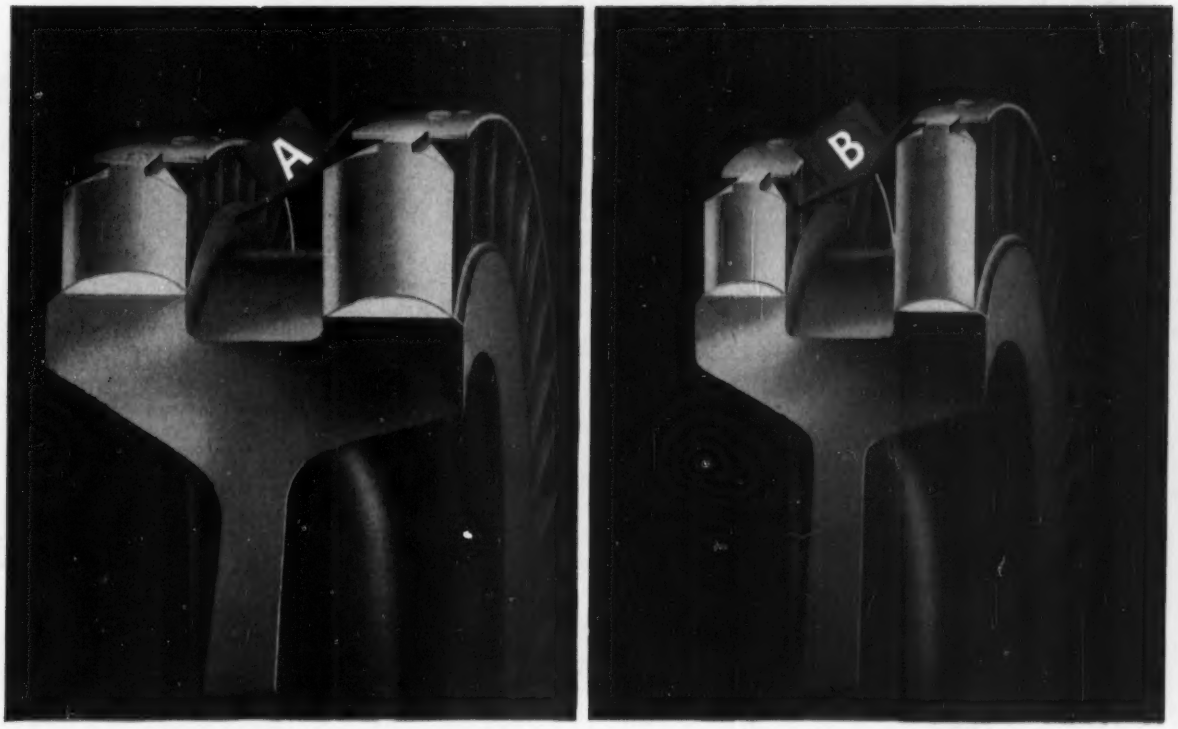
3. Reduces manual attention, and possibility of human error.

4. Provides valuable chart records of column operation.

• •

Send for Data Sheet No. 11 for other control recommendations for batch and continuous distillation; or call in your Taylor Field Engineer. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

Taylor Instruments **MEAN ACCURACY FIRST**



(Left, A) wide bucket "L" type wheel. (Right, B) regular type wheel for Coppus Steam Turbines

Now...for low steam consumption – **COPPUS TURBINES** *can be furnished with wide bucket "L" type wheel*

Good news for steam turbine users where low steam consumption is important!

The Coppus Type "L" Wheel is the answer to this problem. Larger turbine buckets are employed to make the most economical use of steam.

In every respect the Coppus Turbine offers the top-quality features and advantages that have made the Coppus line outstanding for efficiency and economy. For example:

- Turbines rated close to your exact hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther.* Send for Bulletin 135 on Coppus Turbine.

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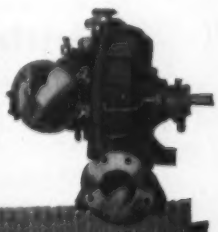

COPPUS "BLUE RIBBON" TURBINES

On the USS Forrestal

Built by the Newport News Shipbuilding and Drydock.

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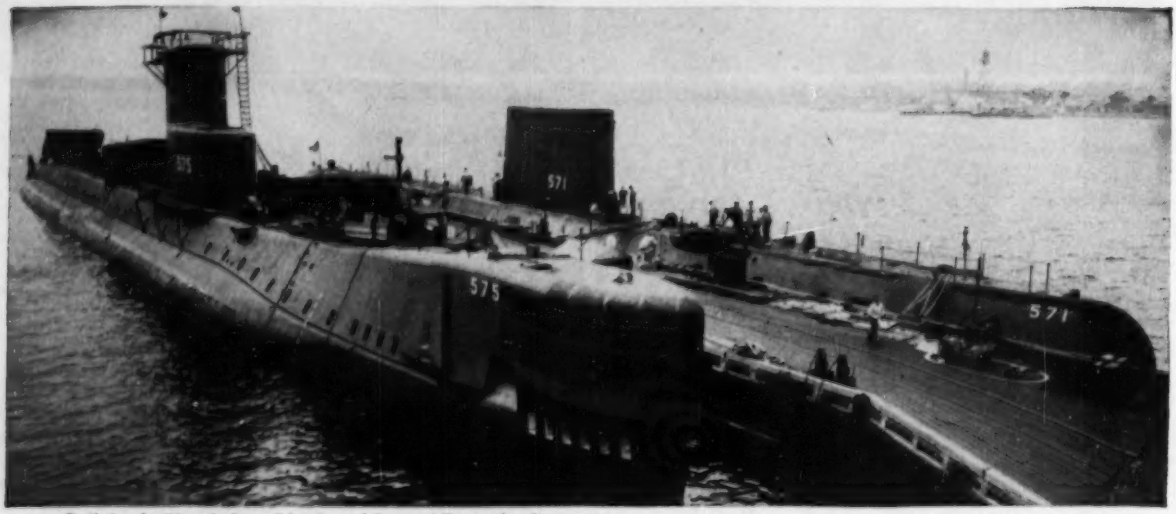

Built by the Electric Boat Division of General Dynamics Corp.

Unibestos insulates vital pipe systems

Guardians of today's security and tomorrow's future—these are the ships of electronic devices and nuclear power...the products of advanced engineering and modern materials.

Aboard these ships, where dependability is a must, Unibestos pipe insulation protects intricate and vital pipeline systems against crucial heat loss. Unibestos makes a clean sweep in its contribution to this important Navy development program.

In fact, Unibestos is fast becoming the preferred insulation for an increasing number and variety of applications. Whether it's a ship, a refinery or a power plant, *single-layer* Unibestos combines high thermal efficiency with superior strength and unmatched ease of installation.

Unibestos® pipe insulation is available in sectional form through 44" O.D. For further information without obligation, write for the free descriptive bulletin 109C.

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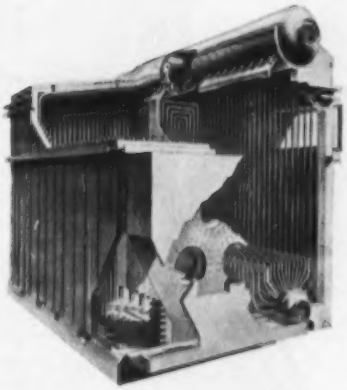
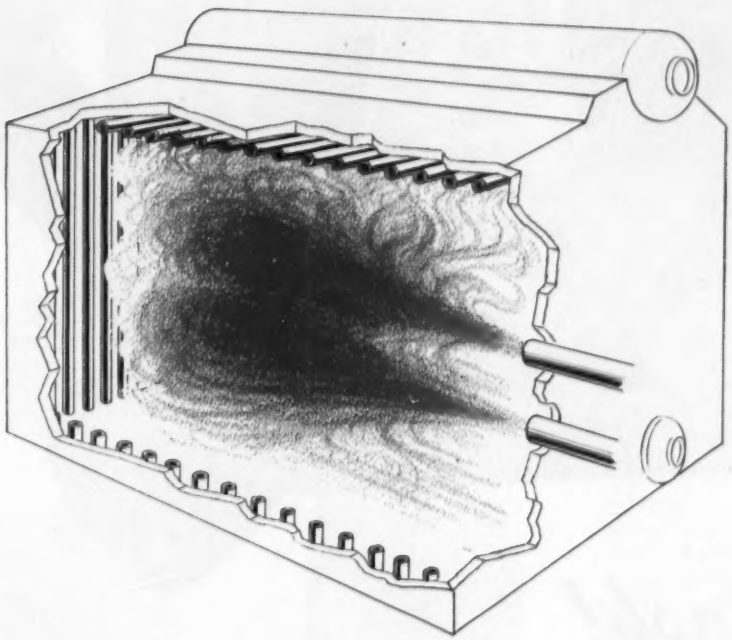
Another Feature of the FW Series "SC" Standard Boiler

EFFICIENT FIRING ARRANGEMENT

assures Longer, Trouble-Free Service





Simplified, schematic diagram showing firing arrangement of typical "SC" steam generator.

The furnace arrangement is carefully designed to permit excellent combustion of the fuel without impingement of the flame on any of the tube surfaces. This prevents harmful overheating and contributes to longer, trouble-free performance.

The rear wall of the firing chamber is over 19 feet from the burner wall, permitting long, horizontal flame travel. The flame envelope, as indicated above, occupies the major portion of available furnace space, greatly reducing ineffective or unused furnace volume. This same basic combustion principle has provided years of successful operation in many other types of FW boilers.

FW Series "SC" Steam Generators are available in capacities from 50,000 to 150,000 lb/hr, for pressures to 1500 psi and superheated steam temperatures to 950 F.

For further information, write for Bulletin B-55-4. *Foster Wheeler Corporation, 165 Broadway, New York 6, New York.*

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- Completely water-cooled walls
- Unrestricted circulation
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- Fully drainable superheater
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- Bottom supported unit
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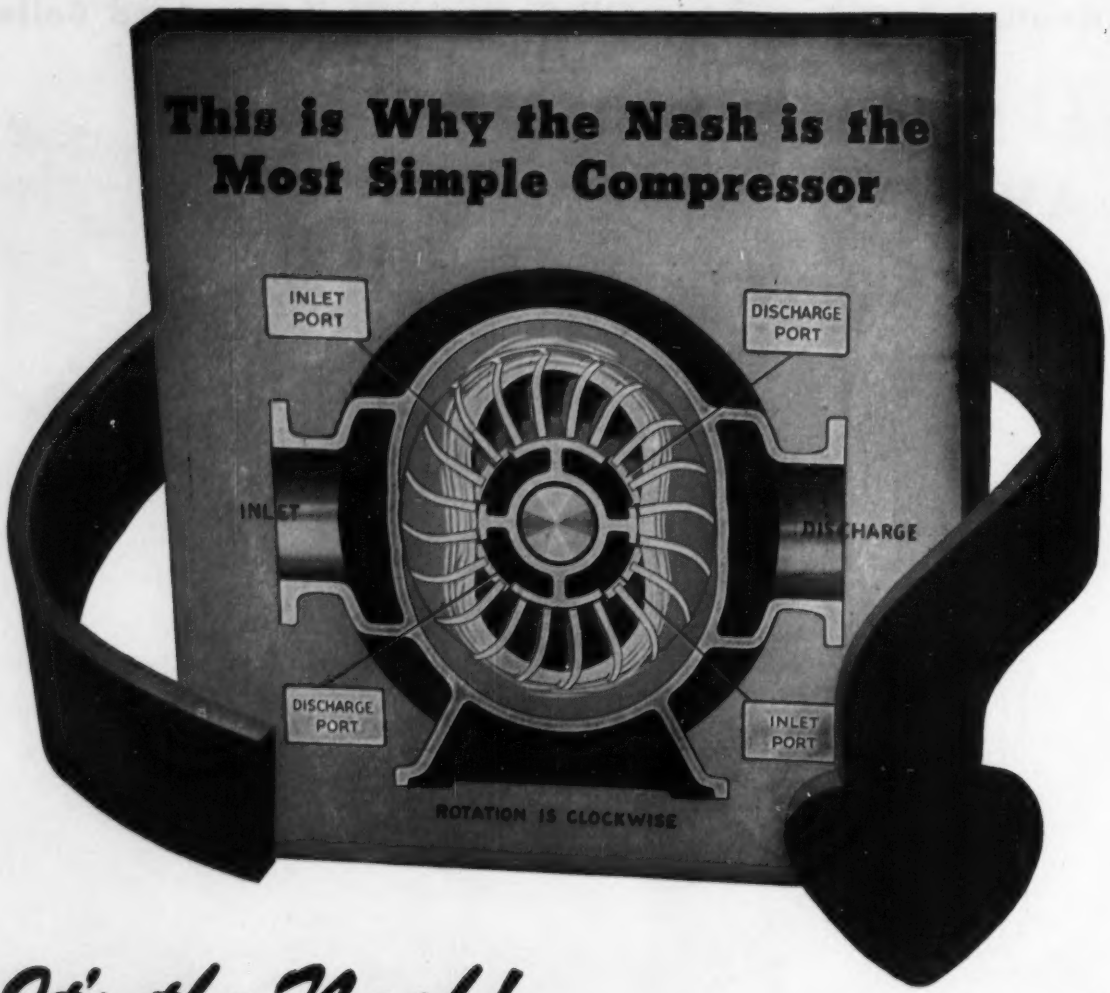

It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY
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In JENKINS *Monel-seated Bronze Gates*

THE WEDGE* TAKES THE WEAR - *and spares the rings*

Easy replacement of the wedge only — right on the line — restores full efficiency

THE MONEL SEAT RINGS are expanded into the body to assure a positive, leak-proof joint. Exhaustive tests in typical monel-seated gate valve services show that this permanent all-around support of the rings is essential to guard against deforming, loosening, or shifting.

***THE RENEWABLE WEDGE** (bronze or nickel alloy) has excellent wear resistance, but has a lower degree of hardness than the heat-treated Monel rings, which have optimum resistance to erosion and corrosion as well as abrasion. Thus, wear of the wedge leaves the rings relatively unaffected. When necessary to renew the wedge, you simply remove the valve bonnet, slip the old wedge off the stem, and slip on a new one.

GET PRACTICAL, LOW-COST RENEWABILITY in the valves you choose for the tough, punishing services that require Monel-seated gates. Compare . . . there is nothing simpler, faster, or more economical than Jenkins replaceable wedge design — and you also get the *plus* of Jenkins *extra value* in every other feature. Jenkins Bros., 100 Park Ave., New York 17, New York.

***MADE WITH BRONZE OR NICKEL ALLOY WEDGE**

The bronze wedge provides lasting economy for most applications. The nickel alloy wedge provides extra resistance where rapid wear and corrosion are factors.

JENKINS BRONZE GATES WITH MONEL SEAT RINGS

200 psi	300 psi
Fig. 270-U, Bronze Wedge	Fig. 280-U, Bronze Wedge
Fig. 270-UN, Nickel Alloy Wedge	Fig. 280-UN, Nickel Alloy Wedge
Fig. 270-UL, Bronze Wedge, U.L. approved for L.P.G. Services	350 psi Fig. 280-UX, Bronze Wedge

JENKINS BRONZE GATES INCLUDE 40 DIFFERENT PATTERNS

125 • 150 • 200 • 300 • 350 psi SOLID WEDGE • SPLIT WEDGE
SCREWED • FLANGED • SOLDER END • SOCKET END QUICK OPENING

Call your local Jenkins Valve Distributor for complete information.

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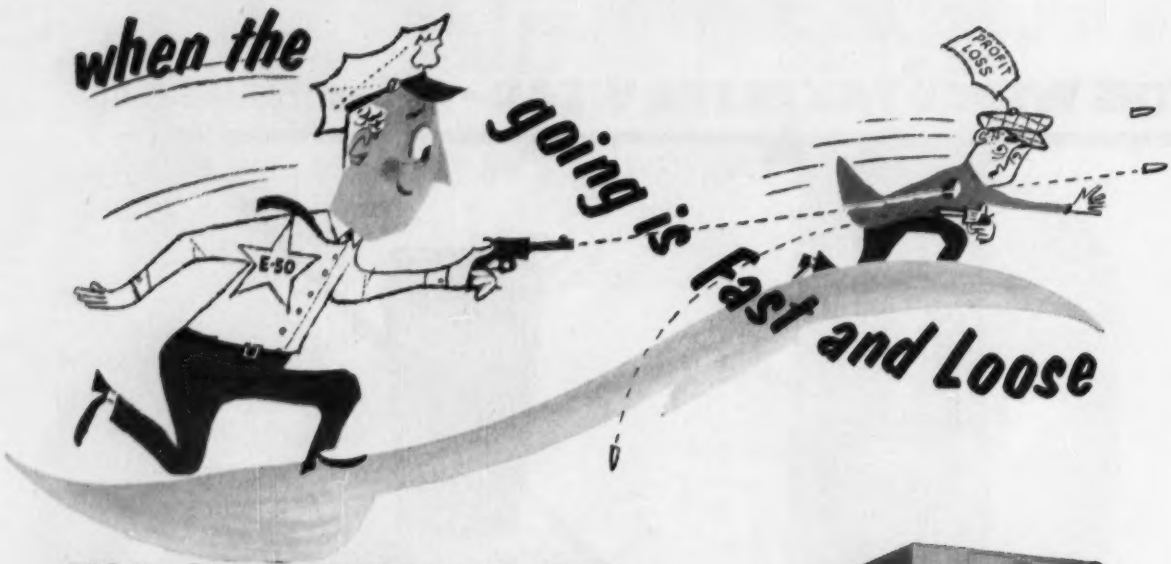


YOU CAN DEPEND ON THE Richardson E-50!

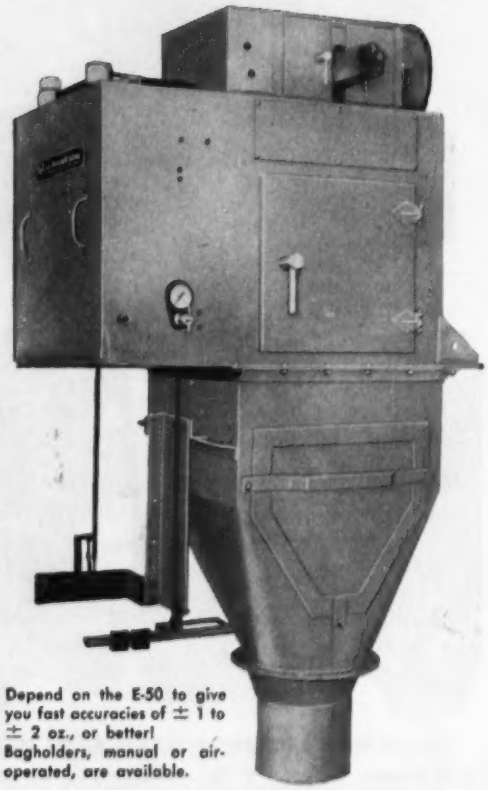
When the weighing is fast and the materials are loose (or even sluggish!), and you're having a running battle with profit loss from weight inaccuracy or the high cost of bagging and scale upkeep . . .

here's one scale that won't let you—or your profits—down!

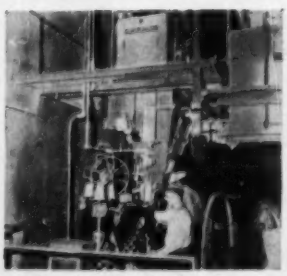
IT'S DEPENDABLE! The E-50's work-horse dependability makes it the perfect choice for any plant *where output vitally depends on the perfection of the bagging scale.* And upkeep is low! You'll find Richardson Scales still in operation after 30 and more years of service.

IT'S FAST, ACCURATE! With the rugged, completely automatic Richardson E-50 you'll get high speed bagging with accuracies *that never before were a practical possibility*—up to 1/10 of 1% under optimum conditions.

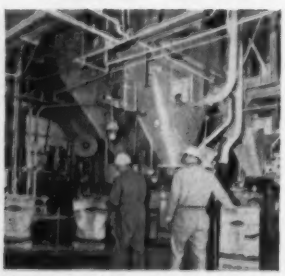
IT'S VERSATILE! Unique design permits the weighing of hundreds of food, chemical, grain and other materials. The E-50 is equally efficient as an independent bagging machine, or as an integral part of a co-ordinated production line packaging system. Don't let weight inaccuracy and bagging costs pick your pockets. Find out about the scale that really unties production tie-ups—Richardson E-50. Write today for free illustrated bulletin #3749A that tells the whole cost-saving E-50 story!



Depend on the E-50 to give you fast accuracies of ± 1 to ± 2 oz., or better! Bagholders, manual or air-operated, are available.



Duplex Model E-50 bags poultry mash up to twenty-two 50-lb. bags per min. at leading feed mill.



Ten 50-lb. bags per min. of antibiotic are delivered from Duplex E-50 in major pharmaceutical plant.

Richardson

MATERIALS HANDLING BY WEIGHT SINCE 1902

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ENGINEERING FLUID-JET GRINDING IN "PACKAGE UNITS"

. . . comes naturally to Sturtevant engineers — with their 75-year tradition of successful solving of dry-processing problems. If you want to accomplish the most effective grouping of a Micronizer* Grinding Machine with necessary compressor, feeder and dust-collector, it will pay you to investigate. Check the coupon on the right for more information.

Sturtevant Micronizer* Grinding Machines Give Greater Finenesses than Tube or Roller Mills

Look at the record! 30 inch model reduced titanium dioxide to 1 micron and finer at solid feed rate of 2250 lbs. per hr. 24 inch model reduced DDT (50%) to 3.5 average microns — 1200-1400 lbs. per hr. 8 inch model reduced Procaine—Penicillin—to 5 to 20 microns—up to 20 lbs. per hr. Couldn't you use milling performances like these?

No moving parts. The particles grind each other. High-speed rotation and violent grinding impact of particles are caused by jets of compressed air or steam at angles to the periphery of the shallow grinding chamber. There are no problems of attritional heat. Centrifugal force keeps over-sized particles in the grinding zone. Cyclone action in the central section classifies and collects the fines for bagging.

Instant accessibility, easy cleaning. Micronizer* Grinding Machines come in seven sizes — each one constructed for quick accessibility and easy maintenance (typified by the "OPEN DOOR" design in other Sturtevant equipment). Grinding chambers range from the 2 in. laboratory size with ½ lb. per hr. capacity to the 30 in. size which handles up to 3000 lbs. per hr.

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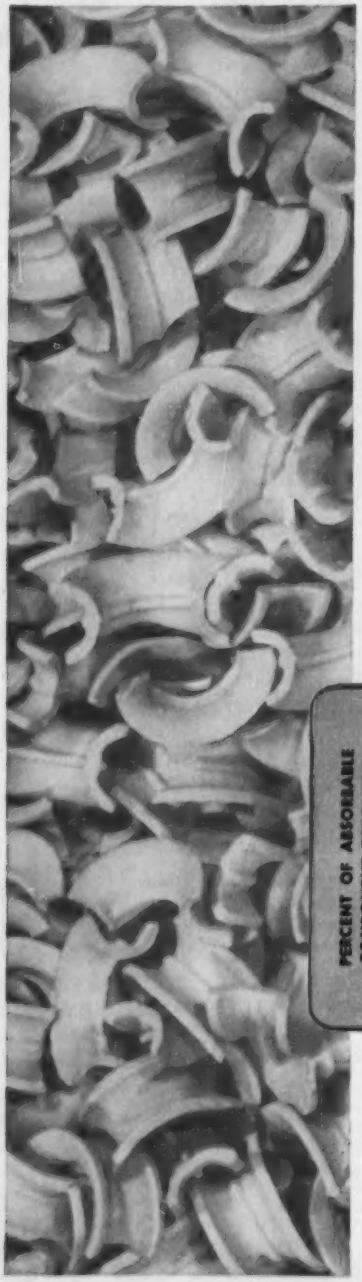
HOW TO INCREASE ABSORBABLE COMPONENT RECOVERED WITHOUT INCREASING HEIGHT OF PACKED COLUMN

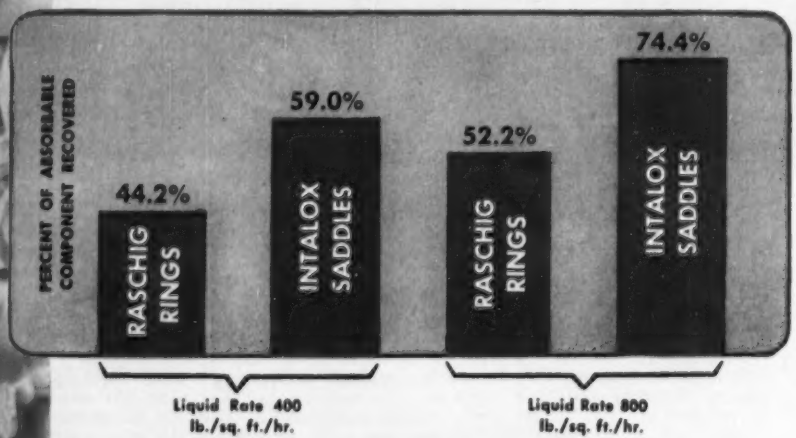


We alternately packed a pilot plant tower first with 10′ of Raschig Rings and then with 10′ of Intalox Saddles. Using identical gas and liquid rates and the same gas composition, absorption data for the two packings were obtained. One swallow, of course, doesn't make a summer, so we repeated the test again and again to be sure our original conclusions were justified.

If you're facing the problem of recovering a higher percentage of absorbable component from your present absorption towers, *it appears obvious* that you can increase the absorption level as much as 30% or more by replacing Raschig rings with Intalox Saddles. And without changing either liquid or gas rates!

Turning the problem around — if you're planning new tower construction for absorption operations — it appears *equally obvious* that tower height can be substantially less If Intalox Saddles are specified for the tower filling.

Actually, the increase in absorption level through using Intalox Saddles can be substantially greater than the test data indicates — for Intalox Saddles permit higher liquid and gas rates to be carried before flooding occurs.



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Gives full technical data and specifications on Intalox Saddles, including comparative charts showing relative pressure drops, flooding limits, gas pumping costs, etc.

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THE UNITED STATES STONEWARE CO.

Process Equipment Division **AKRON 9, OHIO**

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· Chementator

H. T. SHARP

✓ **Stauffer Chemical's new, improved titanium tetrachloride process probably uses a fluid bed for chlorinating. A Stauffer patent, U. S. 2,486,912, describes such an approach, and the firm notes its "experience with fluidized bed techniques" in a recent advertisement.**

✓ **Russia told the World Power Conference held in Vienna last June that it uses continuous-type chamber and tunnel furnaces in its coal carbonization plants.**

✓ **A 220-lb./day pilot plant will soon be making polypropylene for Bergwerksgesellschaft Hibernia AG., Herne, West Germany.**

Adding salt helps to cook out metals

A new one-step chlorination process developed at the Bureau of Mines' Albany, Ore., station promises easier and cheaper recovery of metals and rare earths from the abundant Western black sands deposits.

Although known as a source of columbium, tantalum, titanium, uranium and other elements, high iron content of these deposits has prevented commercial separation by chlorination. The only known separation involves an unwieldy sodium fusion-acid leach process. (Mallinckrodt hasn't yet revealed how it recovers columbium, tantalum and uranium from euxenite mined at Bear Valley, Idaho.)

Heart of the bureau's process is addition of 2-4% sodium chloride to promote formation of stable nonvolatile ferric chloride complexes during chlorination. This cuts iron carryover from about 60% to practically nil.

Heating the chlorination charge to 930 F. for an hour first distills off titanium tetrachloride, then columbium and tantalum chlorides. These latter are condensed separately and separated by selective hydrolysis. Nonvolatile residue can be treated by conventional aqueous methods.

The bureau estimates that production costs on a commercial scale should be well below those of current methods. Other advantages include fewer steps, simple equipment, well-tried operating methods, easy-to-refine (by Kroll reduction) products.

New prilling method uses short tower

Commercial Solvents has just announced a new ammonium nitrate prilling technique for use with the conventional Stengel process (*Chem. Eng.*, July 1955, p. 320). Lower equipment and operating costs, smaller in-process inventory and dense, uniformly spherical prills are features of the method.

Essentially, CSC sprays molten ammonium nitrate, instead of the usual 95% solution, into the top of the prilling tower. Since

no drying is needed, the material requires considerably less than half the free fall needed in the conventional method.

CSC has successfully operated the process for a year in its Sterlington, La., pilot plant and has applied for patents. Licensing will be handled by Chemical & Industrial Corp., Cincinnati, which also licenses the Stengel process.

GE gets cesium from Hanford wastes

The taxpayers are likely to come out a few million dollars ahead when General Electric puts its newly developed cesium removal technique to work on liquid wastes from the Hanford plutonium plant.

Now, these wastes must be stored in steel and concrete tanks while the intensely radioactive cesium "cools off." The element's 33-yr. half-life makes this a costly operation.

The new process, about to be tried in a pilot plant, precipitates the cesium by adjusting the pH of the wastes to about 10 and treating them with zinc ferrocyanide. The precipitate, zinc cesium ferrocyanide, is then centrifuged, dried and calcined (at 570 F.) to the oxide. Cesium recovery is better than 90% and the cesium-free wastes can then be pumped into pits.

GE, which operates the Hanford plant for the Atomic Energy Commission, says that the recovered cesium is potentially valuable in medical therapy, food sterilization and inspection of opaque materials, because it emits X-ray-type radiation. Here its long half-life is an advantage, since it minimizes the need for recalibration and replacement.

American Gilsonite sets spring startup

On-stream date for American Gilsonite's $16-million project to make coke and gasoline from highly resinous asphaltite is now set for the spring of 1957. When plans for the venture were first announced last year (*Chementator*, July 1955, p. 104), startup was scheduled for late 1956.

Billed as world's first large-scale, privately financed attempt to get conventional petroleum products from a raw material other than crude oil, the project includes a number of technical firsts: New "wet" mining techniques will remove the mineral from the company's Bonanza, Utah, deposits; a 71-mile pipeline will transport a gilsonite-in-water suspension over the mountains to Gilsonite, Colo., near Grand Junction; a double-drum delayed coking plant will make 250 tons/day of calcined coke at the refinery, where a catalytic reformer will turn out high-octane gasoline.

Naturally, a pioneering venture of this size ran into a number of delaying snags. One of the knottiest involved economically separating the mineral from the pipeline water at the refinery. This was finally solved by injecting a small amount of oil into the pipeline before it reaches the refinery. Gilsonite's affinity for oil causes the particles to agglomerate and the larger masses can be separated from the water by filtering or centrifuging.

American Gilsonite spent over a million dollars developing its process—much of it on a 100-ton/day (feed capacity) single-drum delayed coking pilot plant at Bonanza. Next month, *Chemical Engineering* will carry a detailed description of the project.

High-temperature problems explored

New processes, new techniques and new materials held the spotlight at the University of California-Stanford Research Institute high temperature symposium at Berkeley, Calif., June 25-27. With emphasis on work yet to be done, conferees discussed how to produce, contain and use temperatures in the 2,000 to 200,000 C. range.

Most of the papers were on a research level. But in this field, with many military and industry problems needing urgent solutions, technological advances follow laboratory findings with startling speed. Chemical industry interest was evident, since nearly every well known company sent at least one delegate.

One problem was tossed right into the industry's lap. A. V. Grosse of Temple University Research Institute told the conference that combustion of carbon subnitrides yields the highest temperature obtainable by chemical means (5,700 C.), but he noted that use of subnitrides is limited since there is no commercial production.

They are now prepared in the lab by dehydrating ammonium salts of acetylene dicarboxylic acid. This method was described in 1886 and there have been no published attempts at developing a better synthesis. Grosse feels that chemical firms might profitably take an interest in these compounds.

(Continued on page 108)

INSIDE STORY:

Why a Heat Exchanger Poses for an X-ray

This technician is giving a clean bill of health to a completed weld on a P-K heat exchanger. Like the x-ray of your chest, this x-ray picture is designed to pick up flaws before they have a chance to become harmful.

Pinholes, lamination, slag inclusions, and all other symptoms of failure are ruled out by this process, which is used to scrutinize the "inside" of *every weld*. Such radiographs are indispensible in manufacturing pressure vessels that will meet every test of time and use. Each x-ray is checked by a representative of the Hartford Steam Boiler Inspection and Insurance Company —for further insurance that every P-K heat exchanger meets or exceeds the rigid standards of the 1952 ASME Code for Unfired Pressure Vessels.

But weld x-rays at P-K represent only a *precaution*. They don't speak for the fact that all P-K welders are ASME qualified for a total of more than 50 types of welding procedures—meaning that the likelihood that flaws will occur at all is minimized. Nor can you see in an x-ray photo the incredibly careful design and calculation that goes into every P-K pressure vessel, to assure that it will be *thermally* and *physically* correct in every way.

Add this all-important knowledge of thermal design to P-K's fabricating and testing procedures, and you have what makes P-K heat transfer equipment different —and better—than all the rest.

Like proof? We'd be delighted to receive your inquiry. The Patterson-Kelley Co., Inc., 180 Lackawanna Ave., East Stroudsburg, Penna. Offices in principal cities.

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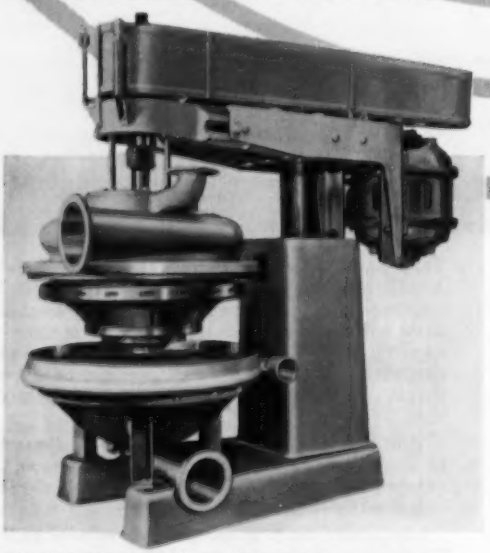
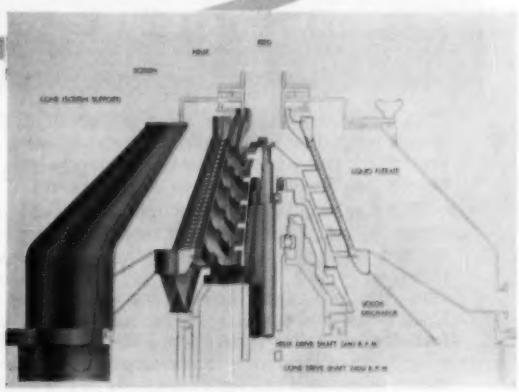
CENTRIFUGAL FORCE . . .

Important Tool for the Process Industries

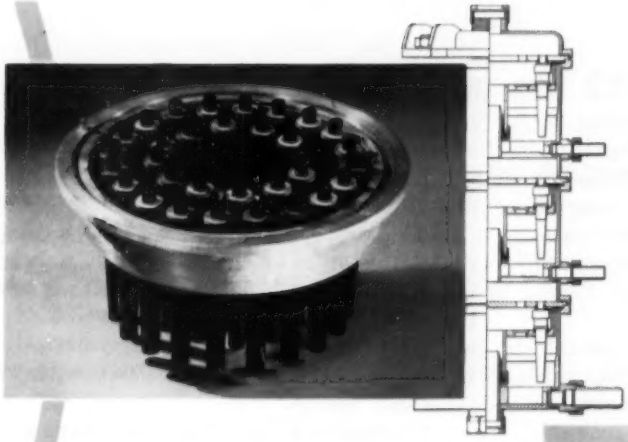
Continuous processing requirements in the Chemical Industries have placed an ever increasing emphasis on centrifugal force. Rounding out an existing line of equipment, Dorr-Oliver is now marketing the products of the Merco Centrifugal Company which was consolidated with Dorr-Oliver on February 1st of this year. The tried and tested Merco Centrifugal Separator and the new Mercone Centrifugal Screen can now be teamed up with a wide variety of DorrClone Classifier designs to meet any wet processing problem where the use of centrifugal force is indicated.



The Merco Centrifugal Separator . . . a continuous, versatile centrifuge for microscopic particle segregation down to 1 micron, for washing and concentration or for soluble recovery. Features built-in hydraulic hoist, overhead bearing and stainless steel rotor and housing. Bulletin No. 4051.

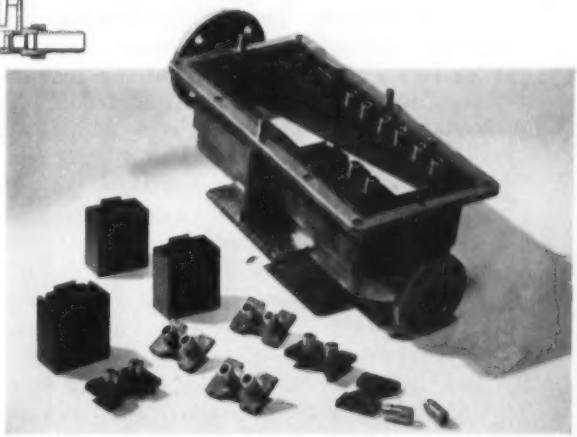


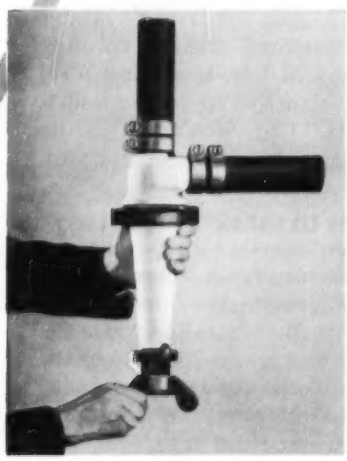
The Mercone Centrifugal Screen . . . a new unit combining the outstanding features of a centrifuge and a screen. Operation is completely continuous permitting large throughput capacity. Cyclo drive operates screen and helix at positive differential speeds . . . solids are conveyed along the screen and discharged in a dry state. Bulletin No. 1555.



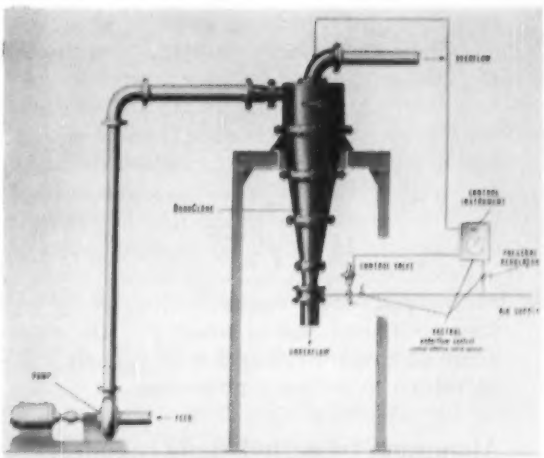
The TM DorrClone . . . combines number of 10 or 15 mm dia. cyclones in a common housing with all cyclones in each stage operating in parallel. Up to three stages can be incorporated in a single unit for separations in the order of 2-3 microns. Bulletin No. 2502.

The M DorrClone . . . Combines molded rubber block cyclones in diameters of 30 and 50 mm installed in a common housing. Type M-30 (containing twenty 30 mm dia. units — illustrated at right) separates at 8-10 microns and Type M-50 (containing ten 50 mm dia. units) at 15-20 microns. Bulletin No. 2504.





The P-50 DorrClone . . . a 50 mm dia. wet cyclone constructed entirely of porcelain. Capacities vary from 7.5 GPM at a feed pressure of 7.5 psi up to 30 GPM at 80 psi. Leaflet No. 2505.



The FR DorrClone . . . a completely rubber lined wet cyclone in diameters of 6″, 12″ and 24″. Features a fixed feed opening and varying vortex finder and apex openings. Capacities vary from a lower limit of 50 GPM for the 6″ unit to 1550 GPM for the 24″ unit. Average separations range from 25 microns in the 6″ to 60 microns in the 24″. Bulletin No. 2503.

Illustrated on these pages are several of the designs Dorr-Oliver has used to harness centrifugal force for the process industries. Only by carefully analyzing the problem can the correct unit specifications be determined. Any or all of the bulletins listed are free on request. When writing we suggest you include a brief outline of the particular application you have in mind. Dorr-Oliver Incorporated, Stamford, Connecticut.

DorrClone, Merco and Mercone TM Reg. U. S. Patent Office

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Also of interest was the prediction by Richard Graham, Atomic Energy Commission, that AEC's studies of nuclear reactors for chemical process heat will lead to reactor designs for 2,000 C. heat within five years. (For Graham's views on the problems and potential these reactors present see *Chem. Eng.*, March 1956, p. 191.)

Containing high temperatures presents its own problems. But a flame-sprayed oxide coating developed by Armour Research Foundation may supply some of the answers. A rutile-titania mixture slightly deficient in oxygen, it is essentially nonporous (in 10-11 mil thickness), quite refractory, harder than quartz, tough and rapidly applied.

ARF is also able to make a chemically inert alumina coating that is harder than tool steel, electrically resistant and high melting, and a zirconia coating that is not wetted by molten metal or glass and forms an excellent high-temperature insulation.

Other high-melting substances mentioned as worth study include ternary carbides and borides and boron phosphide. But research into the basic mechanisms of refractory coatings is the most pressing need.

High temperatures not only open the way to new processes but they also produce a fourth state of matter. In the 20,000 to 30,000 C. range gases become thermal plasmas, highly ionized fluids that conduct electricity.

High pressures were also discussed by conferees and it was revealed that conversion of ammonia to a metallic form by pressures of over 200,000 atm. will soon become a reality. Such pressures affect the stability of the electron orbits and lead to bonding of the atoms. Some of these structures may remain stable on return to ordinary pressures.

Aluminum trimethyl made commercially

Rocky Mountain Research, Inc,. Denver, has announced that it is getting into commercial production of aluminum trimethyl (ATM) —a possible high-energy fuel, Ziegler-type polymerization catalyst and intermediate for making other complex aluminum products.

Now producing the material in a pilot operation, RMR is designing a full scale plant. Process to be used involves reduction of aluminum with a methyl radical carrier (likely a halide), disproportionation of complex intermediates and high vacuum distillation of resulting ATM. The entire sequence must be carried out under anhydrous conditions in absolutely airtight equipment, since aluminum trimethyl has a great affinity for oxygen and flames instantly on contact with air.

This property may make ATM useful as a rocket fuel or as an emergency fuel to relight jet engines after a flameout. RMR says that the product has also been evaluated as a catalyst in Ziegler-type polymerizations (*Chementator*, Jan. 1956, p. 104) with very favorable results.

Currently, ATM is "relatively expensive," but RMR says that the cost can be lowered to a few dollars per lb. on a contract that would keep its production facilities operating for a year or two. Observers note that $12/lb. would be a "logical" price.

Other chemical makers have shown an interest in ATM too. Hercules Powder, which has been making and studying Ziegler catalysts, once considered making it. And National Distillers' USI Div. is making ATM under a 1,000-lb. contract at its research division in Cincinnati. USI won't reveal its process except to say that it's sodium-based.

More money goes to saline water study

Alarmed by the way fresh water supplies are dwindling, Congress gave another big boost to the Interior Dept.'s saline water research program. It first added $200,000 to the $400,000 originally voted for the year ended last June 30, then it voted an additional $550,000 for the current fiscal year.

This vast increase in funds indicates the degree of success of the program thus far. When the program started in 1952, experts figured that it would take five years just to learn if it would ever be possible to make fresh water from sea water at reasonable costs. Now they feel that they can reach their cost objectives (*Chementator*, July 1955, p. 108) in about 15 years.

As outlined to Congress, here's what Interior officials hope to do in the stepped up program:

- Test scale-prevention techniques for two new still designs in a plant-size operation.
- Study solid-liquid phase separation devices and types of refrigerating equipment other than conventional surface freezers.
- Make further studies on the Hickman rotary vapor-compression distillation

(Continued on page 110)

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process (U. S. Pat. 2,734,023). This has shown lower power and equipment costs compared to present commercial stills.

• Try a radically new design of solar still on a much bigger scale than present experimental units. Expected to drastically cut investment costs per unit volume of water produced, detailed designs for the new unit are now being made.

• Improve flowrate and durability of membranes used in a new "reverse osmosis" process that removes 90-95% of the salt in one pass.

• Study more fully an electrodialysis process that shows some promise.

• Build operating cells based on osmionic* cell developments tested successfully in the lab.

New products mark silvichemical spurt

Making chemicals from the non-cellulosic part of the tree is as old as history, but this month's spate of new developments shows that there is no lack of vigor in this venerable industry.

At Scotia, Calif., Pacific Lumber Co. is readying a 10-million-lb./yr. redwood bark extraction plant. A $250,000 continuous unit will replace the 2-million-lb./yr. batch plant that proved the process and provided material for market tests. Chief products are Palconate, a caustic soda extract, and Palcotan, a sulfonated product made by cooking the bark with sodium sulfite and soda ash.

These products have a lower average molecular weight, are made of simpler tannins and are more soluble than lignosulfonates from wood or waste pulping liquor. Palco expects them to be used as dispersing agents, phenol and tannin replacements, etc.

Rayonier has its new Vancouver, B. C., plant for Rayflo, a hemlock bark extract, in about the same stage. The new unit will replace a two-year-old pilot plant at Grays Harbor, Wash., part of which will be used to develop other new silvichemicals.

One product now under study is HT-120, a low-cost, high-grade, resorcinol-type phenolic resin intermediate, identified only as a "sodium salt of a polymeric polyphenol."

Now in clinical evaluation is myricetin, a hexahydroxy-bioflavonoid, which constitutes up to 2% of the bark of certain pine trees. Pre-extraction with benzene removes waxes, fats and resin acids, then ether extraction followed by acetone digestion produces crystals of myricetin. In a commercial plant a cheaper solvent system could be used, but Rayonier won't say which one it has in mind.

In Jessup, Ga., Rayonier just started a new 6,000-tons/yr. tall oil plant. Its capacity will be upped toward the end of '57 when Rayonier puts a second cellulose unit on stream at Jessup.

Crown-Zellerbach also has a number of silvichemicals on the route to commercial production. Beta-conidendrol, a promising antioxidant for resins and rubber and a possible intermediate for fine chemicals, is undergoing market evaluation. Formed from a constituent of the sulfite waste liquor from western hemlock processing, beta-conidendrol is selling at $3/lb. But if market tests are successful, C-Z will build a ton/day plant, which would probably cut the price to about $1.50/lb.

C-Z is also field testing Greenz 30, a zinc complex based on dried sulfite waste liquor and used as a plant nutrient. If successful, it would supplement Greenz 26, an iron-containing complex and C-Z's first product in this field. Research on manganese and copper complexes is also under way.

Oronite to market metaxylene diamine

Oronite Chemical Co., which started commercial production of isophthalic acid early this year, is now probing the market for metaxylene diamine, a new isophthalic derivative whose future seems as rosy as its parent's.

Most promising outlets for the new material appear to be as a curing agent for epoxy resins and as a starting point for high-molecular-weight polyamides and for the diisocyanate intermediate in polyurethane production. Oronite now sells development quantities of the new diamine for $2.50/lb., but commercial production should drop the price to 50-75¢/lb.

Although Oronite hasn't disclosed how it makes its new product, one method of making metaxylene diamine involves hydrogenation of the nitrile formed by reacting isophthalic acid with ammonia. And since Oronite has offered development samples of orthophthalo nitrile in the past, this seems to be Oronite's route.

For more of WHAT'S HAPPENING.....113

* Osmionic cells use perm-selective membranes similar to electrodialysis and ionic cells, but the driving force is the concentration difference between brine and feed water.

EPON® RESIN does it!

Paint job still sound after four years of 100% humidity, high temperature ... in antibiotics plant

All surfaces, except stainless steel, are protected by Epon resin-based paint formulated by David E. Long Corp., New York 17, N.Y.

HERE'S HOW...

PAINT LEADS A HARD LIFE in the steamy antibiotics plant of the New York Quinine and Chemical Works. Day in and day out, paint endures live steam and high temperatures. The coating on the processing equipment is exposed to hydrochloric acid and caustic soda. All surfaces take frequent hosing and scrubbing.

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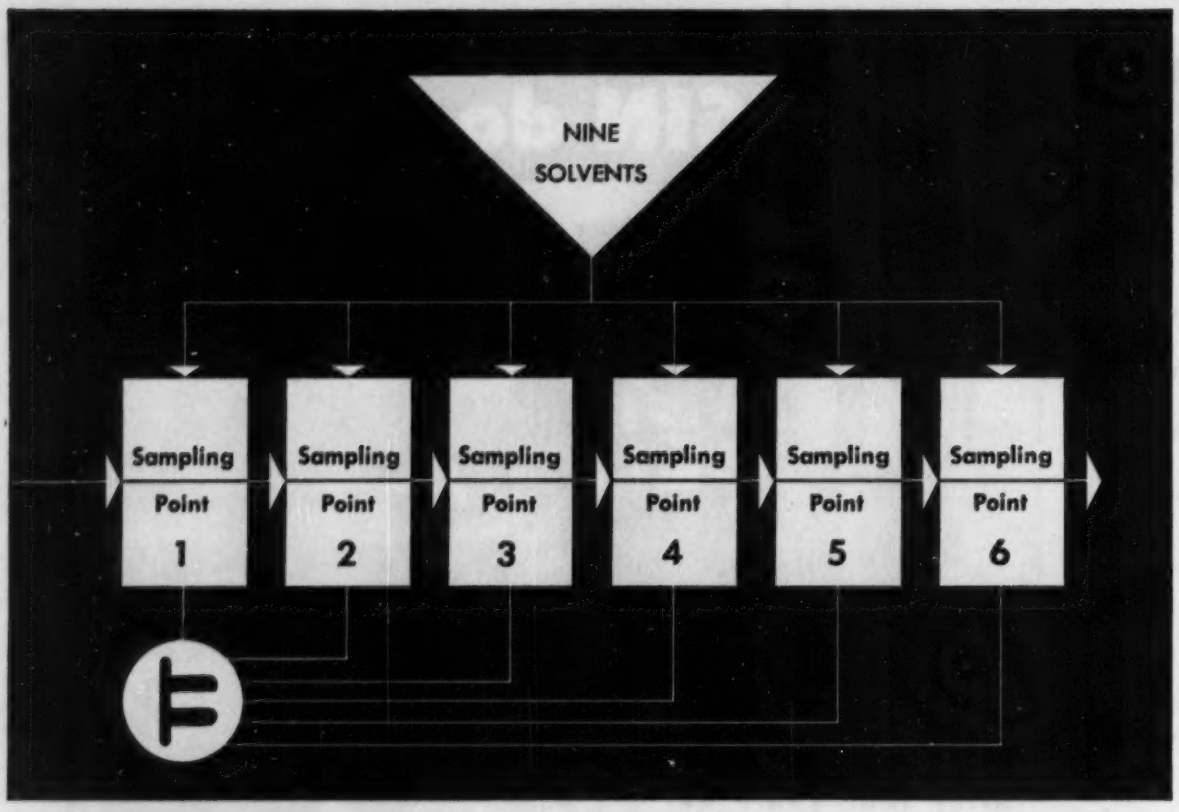

COMBUSTIBLE VAPORS KEPT BELOW EXPLOSIVE LIMITS WITH CONTINUOUS ANALYZERS . . .

Delays in detecting LEL reduced

In a process using nine solvents with lower explosive limits ranging from 1.3% to 13%, a P-E TRI-NON* Infrared Analyzer has the job of reporting vapor concentrations continuously so they can be kept below 80% of the explosive limit.

The TRI-NON analyzer is sensitized to give an equal and linear response for each of the nine solvents. This linearity allows summation of the various combinations at each station regardless of the actual vapor concentration of any one component. Only an infrared analyzer using a selective detector can be sensitized in this manner.

One TRI-NON analyzes samples from six different points in succession along the process line at a speed of 30 seconds per point. Each point is checked every 3 minutes — often enough in this particular application to detect any dangerous change in vapor concentration. (Instrument response times up to 3.4 seconds for 98% of final value are standard.) The TRI-NON is the only infrared analyzer with sufficient speed and stability to cover so many sampling points safely.

In combustible vapor analysis, whether the system contains one or a mixture of solvents, the TRI-NON provides the best zero and range stability available. It does not run into trouble when non-hydrocarbon materials are present in samples. Since it does not burn in order to analyze, deposits do not form in the detecting element and flash-back protection is unnecessary. Maintenance problems are kept to a minimum.

When you specify continuous analyzers for your process streams, P-E alone has a complete line of instruments to choose from. Or let us develop a complete analytical control system for you. Nowhere else can you get the combination of chemical engineering and instrument know-how that you'll find at P-E.

*T.M. The Perkin-Elmer Corp.

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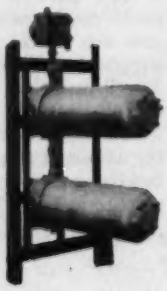


P-E TRI-NON Analyzers are available in a wide range of models and prices to meet all types of continuous analytical problems. They are rugged and dependable, expressly designed for use in the varied environments of a processing plant or refinery. For quick and easy maintenance, instrument components can be tested right on stream — without disconnecting.

What's Happening

AUGUST 1956 FEATURE NEWS

- **Cuts Cost in Making Dry Ice** 114

  Some engineers are thoroughly sold on the advantages of subcooling liquid carbon dioxide with ammonia. Others disagree, favor standard high-pressure process.

- **Geiger Counters Yield Key Viscosity Data** 118

  Here's how Alberta oil-sand researchers measured viscosity of opaque oil-water emulsions; data will help engineers design economical sand-removal facilities.

- **New High-Temperature Polyethylene** 122

  Wire coated with modified polyethylene, after irradiation, can take temperatures up to 480 F.

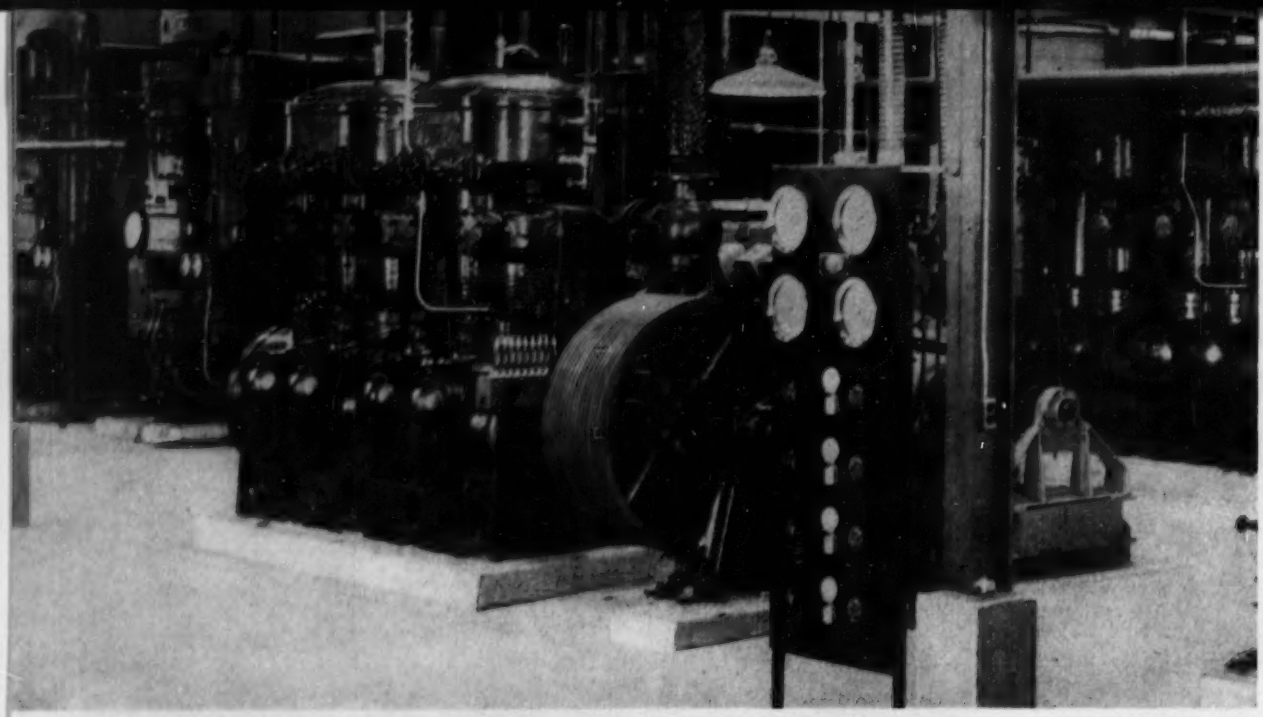
- **Wins Over Economic Odds** 128

  Fundamental approach to design of fertilizer granulation process yields high unit capacity, sparks growing business for young firm in declining market.

- **Air Jets Control Fluid Bed** 134

  Rectangular fluid-bed roaster features four zones of differing bed density and turbulence, achieving stagewise operation without the use of grates.

- **Convention Calendar** 126



Ammonia refrigeration adds extra step to process but, say its backers, it . . .

Cuts Cost in Making Dry Ice

Some engineers are thoroughly sold on the advantages of subcooling liquid carbon dioxide with ammonia. Others disagree, favor standard high-pressure process.

Traditionally, dry ice manufacturers supplement their water cooling of liquefied carbon dioxide with ammonia refrigeration only when they can't get enough cold (less than 75 F.) water.

Frick Co., refrigeration engineering firm of Waynesboro, Pa., now recommends that dry ice plants use ammonia refrigeration even where there's plenty of cold water to be had. Reason: Ammonia refrigeration, providing lower liquid CO_2 temperatures, reduces the amount of cooling which must be supplied by expansion of the CO_2 itself. It thus makes possible the use of lower operating pressures and reduces the proportion of flashed vapor which must be recompressed. Result: Lower installation and operating costs.

▶ **Case in Point**—Although some veteran dry ice men disagree with this premise, it was with this philosophy that Frick designed, built and supplied the major equipment for Colorado CO_2 Corp.'s new low-pressure dry ice plant near Las Animas, Colo. On stream since early this year, the new plant presses out 50 tons of dry ice per day from natural-well carbon dioxide.

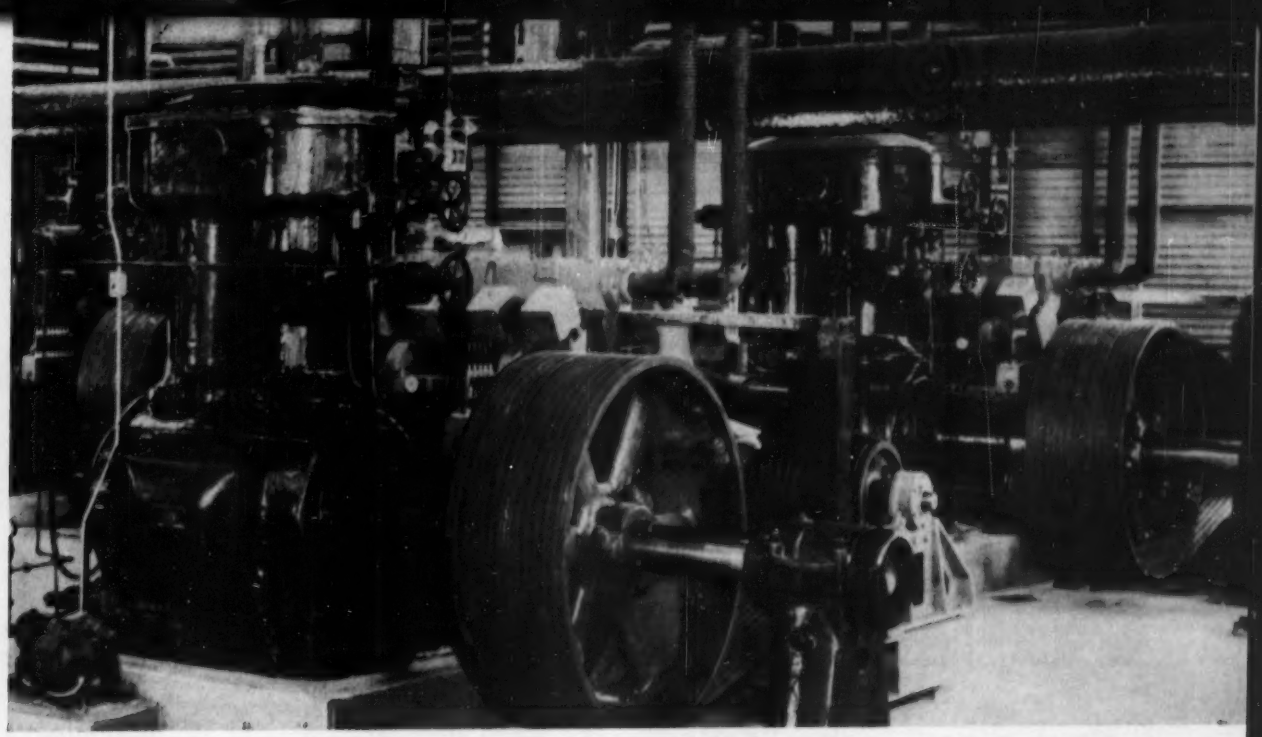
CCC uses a standard ammonia refrigeration unit, gets by with a top CO_2 pressure of 250 psig. (*see above cuts*). All other plants in that area cool with neighborhood water, run at much higher (1,000 psig.) pressures.

▶ **Saves These Ways**—M. W. Garland, Frick's chief engineer, reports that CCC's ammonia-cascading plant cost 40% less to build and run than the others. Economies, Garland explains, spring from the following considerations:

• *Sliced Operating Costs*—Relatively warm (80 F.) liquid CO_2, obtained by condensing with water cooling, must be further cooled by a series of expansions from a high initial pressure before it can be flashed to dry ice. During this operation a large volume flashes away as gas. It costs money in extra power consumption, Garland stresses, to recirculate and reprocess this gas to liquid feed for the dry ice presses.

But liquid CO_2 which has been deeply subcooled by ammonia refrigeration can be flashed directly through its triple point from a much lower initial pressure. Thus a higher proportion of the initial feed is converted to snow; less blowback gas needs to be reprocessed.

Besides reducing the volume of gas which must be recompressed, the binary cycle also reduces the required pressure. Compression ratio of the CO_2 cycle runs about one-fourth that of high-pressure plants. And the extra compression needed for the ammonia cycle does not totally cancel out this advantage. Over-all power consumption, Garland claims, is



Reduces the load on the main CO_2 compressors, saves on power and investment.

still way down—about half that of water-cooled plants.

• *Sliced Installation Costs*—Low-pressure processing uses lighter compressors and sidesteps the need for other expensive, high-pressure equipment. CCC's plant was fitted together with low-cost, standard items of equipment.

▶ **Visible Support** — Cardox Corp. backs Frick's thinking. It went on stream last year with low-pressure binary plants at Ventura, Calif., and Memphis, Tenn. (see *Chem. Eng.*, July 1955, p. 120).

The company found marked economies in capital and operating costs. Cardox reports less power, equipment and labor needed to make dry ice.

▶ **A Dissenting Voice**—H. A. Sommers, dry ice expert from Food Machinery and Chemical Corp., takes issue with Frick's philosophy. His position: Go to ammonia refrigeration only when there's no cold water available or when a high price must be paid to get it.

As he puts it, "Savings on low-pressure equipment and on power are more than wiped out by the added complexity of operation and maintenance, by increased numbers of items required by the ammonia freezer. There's nothing mysterious about high-pressure plants. They are compact, neat packages, cheaper to build, run and maintain."

▶ **A Milder No**—Pure Carbonic Corp. takes the middle ground. Evan Pugh, plant engineering manager, calls it ". . . an economic toss-up. What is saved with low-pressure equipment is spent for the ammonia system and its accessories."

Power savings don't carry much weight with Pure Carbonic. Granting that they do exist, Pugh points out, "We produce our own power and usually have plenty to spare. So we don't worry much about that." And, he indicates, that's the case with most dry ice producers. But when power must be bought, Pugh agrees, low pressures make the checks smaller.

Pure Carbonic lets availability of water dictate its choice between the two avenues to dry ice. To show how faithfully it sticks to that dictum, Pure Carbonic can point to its dry ice plant at Niagara Falls, N. Y. That plant uses ammonia refrigeration in the summer when the cooling water climbs over 75 F., water-cooling and high-pressure expansions during the winter when the water runs below that figure.

▶ **How Process Works**—CCC's plant represents a good example of the low-pressure, ammonia-cooled dry ice process.

A booster compressor delivers the CO_2 at 25 psig. to the plant via an 8-in. pipeline from the five-mile-distant natural well. Cold gas flashed from the dry ice presses lowers the temperature of the stream in a mixing drum, then in an exchanger, dropping out much of the entrained water.

CO_2 is drawn into a pair of standard enclosed compressors. The two machines discharge at about 250 psig. into a water-cooled, shell-and-tube exchanger. Four vertical silica gel filters scrub compressor oil out of the gas streams.

Key operation of the low-pressure process occurs in a vertical shell-and-tube exchanger. Liquid ammonia, kept at −28 F., evaporates in the tubes. CO_2, passing through the shell side, is liquefied and substantially subcooled.

▶ **Cooling Way Down**—From a receiver the liquid stream goes through a single-pass exchanger, further subcooled there by blowback gas at −100 F., and then to two dry ice presses. (Blowback gas continues on its way to the mixer referred to above.) *(Continued)*

DRY ICE from presses is sawed into 10x10x11-in. blocks.

Though under only low pressure, the CO_2 is so cold that it shivers on the brink of solidification. When expanded into the chambers of the presses some 43% freezes as snow. The rest recirculates as blowback gas.

Each press applies 2,400 lb. pressure to pack the snow into 20x20x11-in. blocks. Two bandsaws slice the blocks into the 60-lb., 10x10x11-in. marketable product.

Dry ice blocks, wrapped in paper, are shipped by insulated trucks throughout the Southwestern states. The trucks, part of a privately owned fleet, make the circuit of other nearby dry ice plants as well, picking up and delivering the product to markets en route.

▶ **Ammonia Goes Around**—A small refrigerating plant keeps the ammonia in action.

Two four-cylinder machines compress the ammonia after it has absorbed the CO_2's latent heat and vaporized in the condenser. Under pressure, the ammonia gas is condensed in a water-cooled, eight-pass, shell-and-tube heat exchanger. Then, recycled, the ammonia returns to work with little loss.

▶ **More on the Way?**—Frick's Garland feels that a definite trend to this type of dry ice manufacturing will develop. And the impetus for the trend will hinge strictly on the economics of low-pressure processing. Cardox agrees.

Carbonic's Pugh, however, feels that such a trend would develop only if cold water, generally, becomes in short supply. FMC's Sommers supports Pugh and, further, doesn't think that such a shortage is in sight.

Province Full of Forests Marked for Fireproofing

Rainmakers are confident that they can keep British Columbia's forests wet enough through the usually rainless summer season to eliminate the long-standing practice of closing tinder-dry areas.

North America Weather Consultants of California, already under contract to the B.C. Power Commission and Crown Zellerbach Canada Ltd., presented the broad outlines of a plan to protect the forests to officials of the provincial forestry department.

This spring, the B.C. Power Commission renewed its contract with the rainmakers for a second year, and the company now is operating a number of generators on northern Vancouver Island, bombarding clouds with rain-spawning silver iodide particles. The government-owned power commission wants the extra precipitation to feed its island hydro generators.

And Crown Zellerbach found that rainfall during the summer was not sufficient to meet needs of its Ocean Falls newsprint plant, hired the weather consultants to avoid cutting output.

Cost Engineers Form Professional Group

American Assn. of Cost Engineers was organized at a June meeting held on the campus of the University of New Hampshire, Durham, N. H. President of the new group is Norman G. Bach, supervisor of engineering services for Monsanto at Texas City, Tex.

Constitution and By-Laws were adopted by 61 engineers and estimators attending the meeting. Others joining the association before September 1 will be added to these as charter members.

Primary objective of the AACE will be "to advance the science and art of cost engineering in or related to the process industries." The group defined the cost engineering function as "the application of scientific principles and techniques to problems of cost estimation, cost control and profitability."

Vice president is J. W. Hackney, chief construction engineer for Diamond Alkali Co., Cleveland; secretary is John T. Husted, chief estimator for American Potash & Chemical, Trona, Calif.; treasurer is Bruce R. Landis, chief estimator for C. W. Nofsinger Co., Kansas City, Mo.

Elected to serve as directors were: George D. Carameros, El Paso Natural Gas Co., El Paso, Tex.; C. A. Miller, Canadian Industries Ltd., Montreal; Cecil H. Chilton, *Chemical Engineering*, New York; and Irvin Lavine, Industrial Research Service, Dover, N. H.

Serving also on the board of directors, in lieu of a past president, is O. T. Zimmerman, University of New Hampshire.

Gas-from-Coal Process Gets Plant Try

Olin Mathieson's new experimental unit for production of synthesis gas by partial oxidation of coal at Morgantown, W. Va., has just started up.

Developed by Texaco Development Co., process used is already in commercial operation elsewhere, utilizing natural gas and fuel oil as raw materials, and a small pilot unit has operated successfully on coal. The Morgantown unit will be the first test of its workability for commercial-scale operation using coal.

Process involves the partial combustion of coal with oxygen at high pressure. Synthesis gas produced consists mostly of hydrogen and carbon monoxide, suitable for manufacture of ammonia, methanol and related chemicals.

The Morgantown unit will be capable of turning out enough gas to make about 80 tons/day of ammonia or equivalent methanol. The size is the same as that anticipated for units to be used in commercial operation.

DESIGNING ENGINEERS AND CONSTRUCTORS

LUMMUS

FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

385 MADISON AVENUE, NEW YORK 17, NEW YORK

First High Pressure Acetylene Chemicals Plant In U.S. Now In Operation

Plant Built By Lummus For General Aniline & Film Corporation At Calvert City, Kentucky Has Been Operating Smoothly Since Startup

Early in 1956 the first full scale commercial installation in this country for the production of acetylene chemicals by high pressure techniques was placed in operation at Calvert City, Kentucky. It was engineered and constructed by The Lummus Company based on General Aniline & Film Corporation's design. GAF is the pioneer of high pressure acetylene technology in this country.

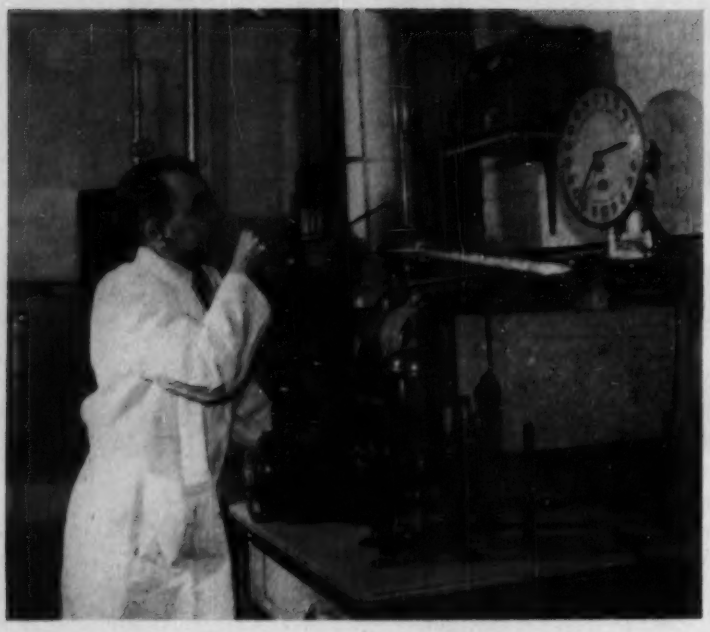
The chemicals presently manufactured include propargyl alcohol, butynediol, 1,4-butanediol, butyrolactone, pyrrolidone, vinylpyrrolidone, polyvinylpyrrolidone (PVP).

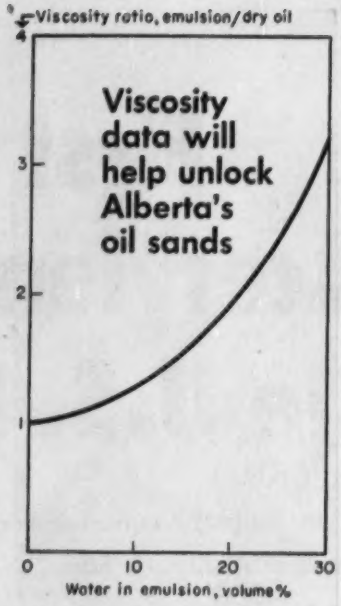
As a result of extensive research, pilot plant production and market development by GAF, these products already have wide acceptance industrially for use in cosmetics, pharmaceuticals, detergents, plastics and plasticizers, fibers, textile auxiliaries, solvents, corrosion inhibitors and germicides. With full scale commercial production now under way, industry will be able to obtain these materials at new low prices and in multi-million pound quantities.

The engineering and construction of this new and unusual processing plant required the closest cooperation between GAF and Lummus personnel at all levels, and it proceeded smoothly through a successful startup.

This project is one more indication of the ability of The Lummus Company to handle challenging installations for the chemical process industries. Look to Lummus when you have a unique engineering and construction problem.

THE LUMMUS COMPANY, 385 Madison Avenue, New York 17, N. Y. **Engineering and Sales Offices:** New York, Houston, Montreal, London, Paris, The Hague, Bombay. **Sales Offices:** Chicago, Caracas. **Heat Exchanger Plant:** Honesdale, Pennsylvania. **Fabricated Piping Plant:** East Chicago, Indiana.





Geiger Counters Yield Key Viscosity Data

Here's how Alberta oil-sand researchers measured viscosity of opaque oil-water emulsions; data will help engineers design economical sand-removal facilities.

If and when petroleum is produced commercially from Alberta's McMurray oil sands, atomic radiation can take credit for a key role in this development.

Hope for successful exploitation of this vast hydrocarbon resource* relies heavily on the viscosity data shown in the graph above. This plot shows how the viscosity of certain oil-water emulsions increases as water concentration of the emulsion goes up. When used with Stokes' law, these data provide the key with which engineers can predict the settling rates of sand particles through a wide variety of emulsions.

Emulsion viscosity data were obtained in the University of Alberta's laboratories at Edmonton by dropping radioactive steel balls through opaque emulsion samples and measuring their rate of fall with a pair of Geiger counters.

▶ **Find Settling Speed**—Alberta Research Council's favored "hot water" method of extracting heavy oil from the McMurray sands yields an oil-water emulsion suspending up to 10% sand particles. Before any further processing or transporting of the emulsion is possible these particles must be removed.

Settling represents one way, settling time the clue to commercial feasibility of that way. If settling time is not long enough the emulsion remains impure and the sand, settling out later, fouls equipment and piping. But if settling time is overlong—to insure emulsion purity—production is wastefully delayed and costs are out of line.

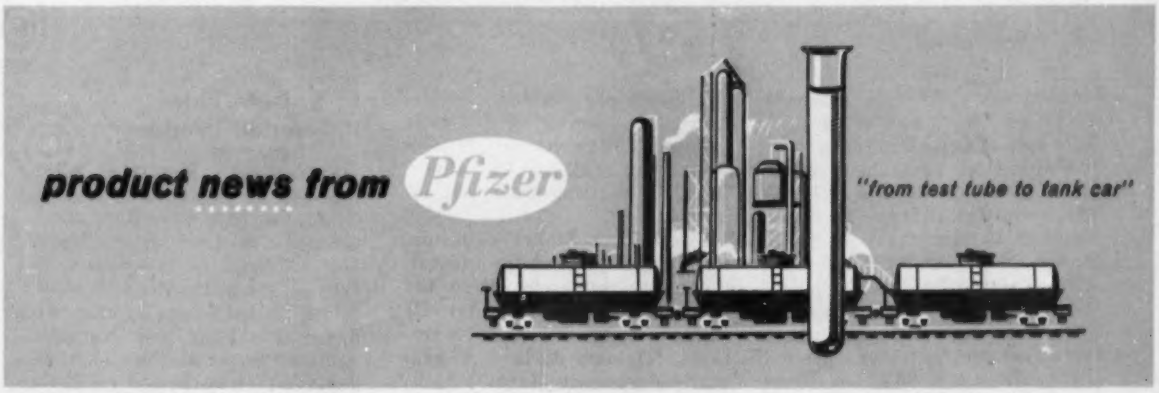
Credit Edward Tipman, of the University's chemistry department, for furnishing the formula that finds the happy time between these two extremes.

▶ **Viscosity Is Missing**—Stokes' equation, with certain limitations, predicts the rate of a solid particle's free fall through a fluid when, among other quantities, viscosity of the fluid is known. Tipman determined that in the McMurray oil-sand case Stokes' limitations were either met or could be neglected. And of the other required quantities, all were readily at hand except for one. Only the viscosity of the emulsion was missing.

So that's what Tipman's research supplied—an equation that computes the viscosity of the McMurray oil-water emulsion, based on the dry oil's viscosity and the volumetric water concentration of the emulsion.

Reproducing the emulsions in

* See *Chem. Eng.*, June 1955, p. 130. If placed on a commercial basis, crude oil recovery from oil sands promises 2,000-yr. petroleum supply at current rate of consumption.



VERSATILE ORGANIC ACIDS AVAILABLE IN QUANTITY

● When Pfizer opened the world's first successful citric acid fermentation plant in 1923, the world price of citric dropped more than two-thirds! Since that time Pfizer leadership in fermentation chemistry has made many other useful acids available to industry in quantity.

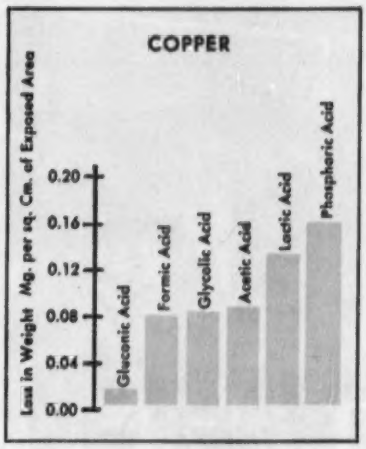
CITRIC ACID

Pfizer offers citric acid in both anhydrous and hydrous forms. With Pfizer's anhydrous form of citric acid, you save money in reduced freight costs. Why pay freight for 8½ lbs. of water per each 100 lbs. of citric shipped? In addition the anhydrous form offers the advantage of ideal quality control since there is little or no variation in moisture content.

Citric acid is a relatively strong acid notable for its nontoxicity, its sequestering ability and the number of chemical reactions it will undergo. Pfizer also offers citric acid salts and five esters in commercial quantities. These are Triethyl and Tributyl Citrates as well as their acetylated forms. Acetyl tri-2-ethylhexyl citrate is also available.

GLUCONIC ACID

By the fermentative oxidation of glucose, Pfizer produces gluconic acid, which it offers as a 50 percent aqueous solution and in the form of stable salts. Gluconic acid has a low order of toxicity, is extremely mild and non-corrosive and has excellent sequestering properties. Tests at Pfizer have shown that 1N gluconic acid solutions affected metals less than any of five other mild acids. Consider copper for example:



OXALIC ACID

Pfizer developed a fermentation process which yields oxalic acid in a high degree of purity. One of the outstanding features of this strong acid is its ability to solubilize iron oxide. Pfizer Oxalic Acid is available in granular and fine granular forms. Ammonium, ferric ammonium, ferric and other oxalates are also available.

TARTARIC ACID

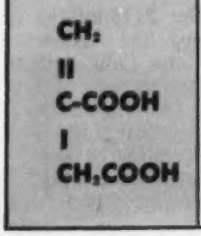
Crystalline deposits in wine fermentation vats provided the raw material from which Pfizer began producing high purity tartaric acid in 1862. Like citric and gluconic acids, tartaric acid is notable for its low toxicity and its sequestering activity.

ITACONIC ACID

Pfizer skill in fermentation has made industrial itaconic acid a reality. Two carboxyl groups, a conjugated double bond and an active methylene group make itaconic acid a reactive and versatile molecule. Itaconic esters, readily prepared in high yields, can be polymerized and may serve as useful plasticizers. Polyesters of itaconic acid and glycols may be polymerized or copolymerized to hard thermoset resins.

You can order versatile PFIZER ORGANIC ACIDS in large tonnages. If you want further information on any of them, write us outlining the type of application you are considering. Pfizer Technical Service can help you with extensive data on organic acids.

PHYSICAL PROPERTIES OF ITACONIC ACID



Formula	$H_2C_5H_4O_4$
Molecular Wgt.	130.10
Appearance	white crystalline powder
Melting Point	167-8°C
Solubility in Water	
At 20°C	8.3 Gm./100 ml.
At 80°C	72.5 Gm./100 ml.

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his laboratory, Tipman dropped solids into them and measured their rate of fall. For the solids he obtained six radioactive steel balls from the Chalk River, Ont., atomic energy facility. Ranging in size from $\frac{1}{16}$ to $\frac{1}{8}$ in. dia., they simulated the McMurray sand particles.

For the emulsion he made up samples of McMurray oil, ranging in volumetric water concentration from 0 to 35%. And for a wide spread of viscosity results he ran the tests at 70, 100, 130, 160 and 180 F.

▶**Signaling Geiger Counters**—Tipman circulated each of the fluids slowly through a 5 ft. 6$\frac{1}{2}$ in.-long by 2$\frac{1}{8}$ in. I.D. settling tube. Two Geiger counters were set, one near the top and the other near the bottom of the tube, an accurately measured distance apart.

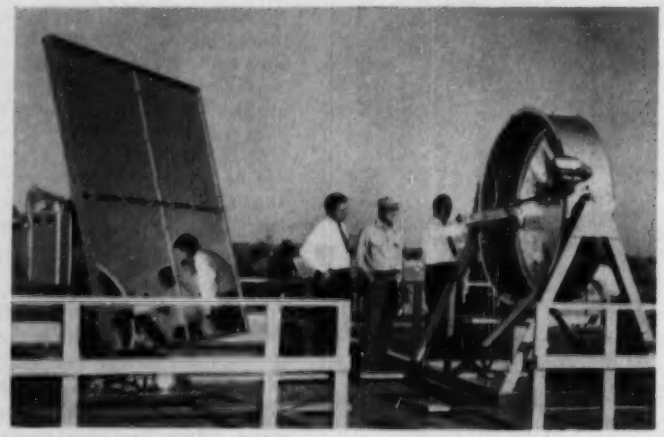
As each "hot' sphere settled past the top counter its emitted gamma rays triggered an electronic timing device. And in passing the lower counter the spheres, in the same way, cut off the timer. Thus the settling time was obtained.

Slipped into Stokes' equation, these rates yielded the viscosities of the emulsions. From the plot of viscosity ratios (dry oil: emulsions) vs. water concentrations, Tipman derived a generalized viscosity formula:

$$\mu = \mu_o(1 + c + 14c^2 + 26c^3)$$

where μ is the viscosity of the emulsion, μ_o the viscosity of dry oil—in absolute units—and c is the volumetric concentration of water in the emulsion, expressed as a decimal.

As a useful correction of Stokes' law, this equation offers engineers a valuable tool in the handling of heavy oil emulsions and, specifically, a means of determining the settling speed of solids through this type of emulsion.



New Solar Furnace Produces 3,500 C.

A 3,000-lb., $10,000 solar furnace now in operation at the University of Arizona will be used in high-temperature research on metals for jet aircraft, rockets and other missiles. It concentrates heat into a $\frac{1}{2}$-in. target, reaching 3,500 C. and melting most metals so rapidly that the melting cannot be observed in process. It provides the effects of instantaneous heating on materials, giving a "clean" heat, free from contamination of a flame or other means of combustion. A larger solar furnace will be built by the U. S. Air Force near Alamogordo, N. M. It is expected to attain radiation temperatures near 4,000 C. over a larger area than any existing furnace.

U. S. Gets Third Polyamide Producer

Polyamide (nylon-type) plastics will be produced by Foster Grant Co. in a $1-million plant planned for Leominster, Mass. More widely manufactured in Europe, the product is now made in the United States by only two firms: Du Pont and National Aniline. Foster Grant's plant is due to start up by spring 1957.

Huge Phosphorus Furnace Nears Completion

Shea Chemical Corp. is completing a $5-million expansion program which includes installation of the largest phosphorus furnace in the country. Located at Columbia, Tenn., the furnace features a 42,000-kva. transformer, utilization of 45-in. graphite electrodes and a precipitator of new design.

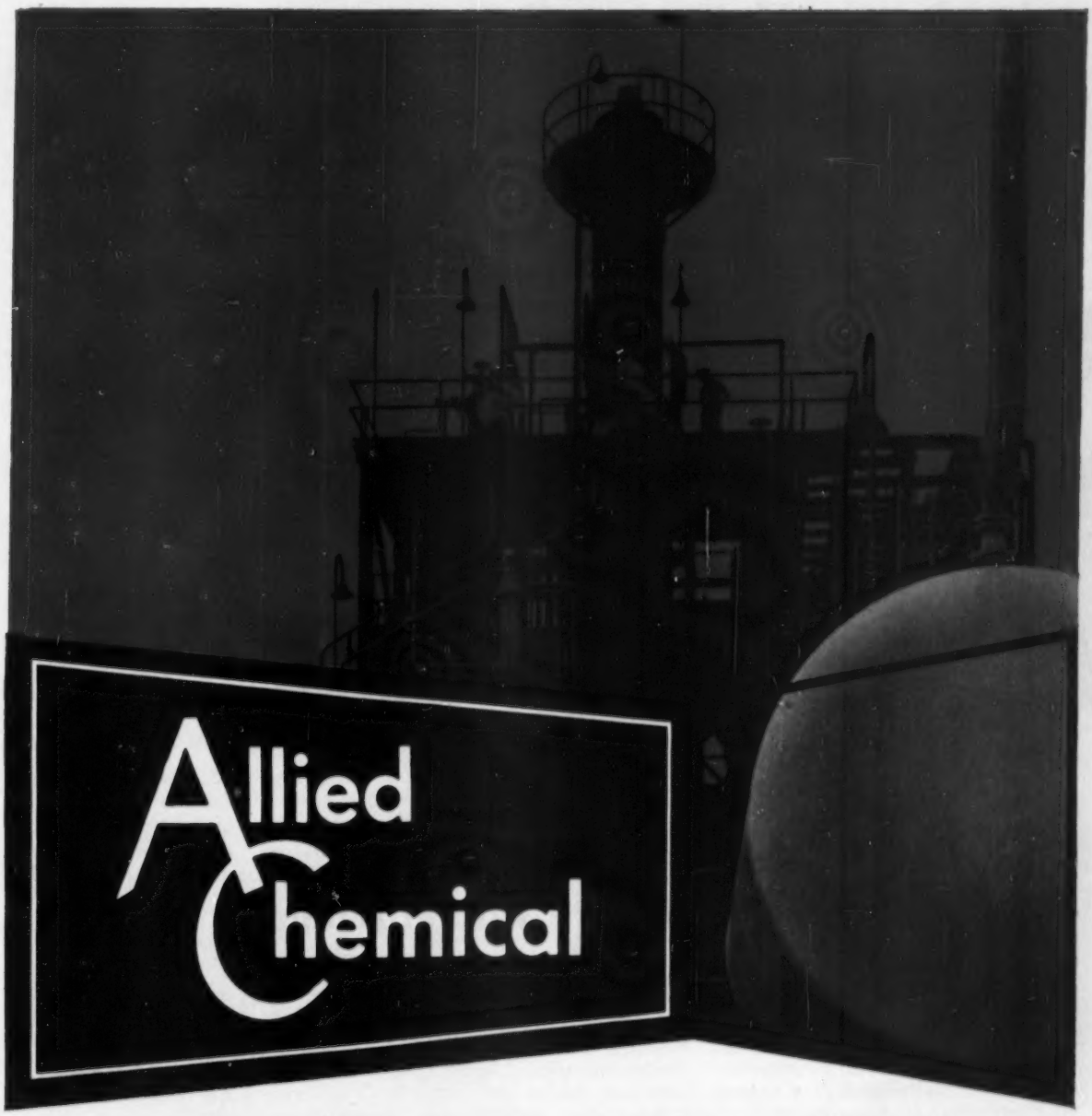
Total output of 45,000 tons/yr. of elemental phosphorus will come from Columbia facilities, which include an older furnace, one that has recently been enlarged.

Shea's over-all four-plant enlargement program adds 140% to the firm's capacity for producing elemental phosphorus. Sales in 1957 are expected to be double the $10 million estimated for this year.

At Adams, Mass., the firm's expansion program has resulted in new facilities for research and pilot-plant work on organic chemicals. At Dallas, the firm is building a 60,000-ton/yr. plant for utilizing elemental phosphorus in the production of sodium phosphates and phosphoric acids. At Jeffersonville, Ind., new acreage has been bought for future plant growth.

New Steelmaking Plant Uses Oxygen Process

Included in the $113-million expansion planned for Kaiser Steel Corp.'s Fontana, Calif., mill will be an oxygen process for making steel (*Chem. Eng.*, Feb. 1956, p. 122). The third plant of its kind in the country, it will raise the company's production of steel ingots 40%.



ETHANOLAMINES

Need mono-, di-, or triethanolamine? Allied's Orange, Texas, plant – most modern in the industry—can supply you with ethanolamines consistently above standard specifications. Shipments in tank cars, tank trucks or 55-gallon drums available from Orange, Texas. Nationwide stocks for delivery by tank truck and 55-gallon drums. Phone or write for samples, quotations, literature, technical service with no obligation.

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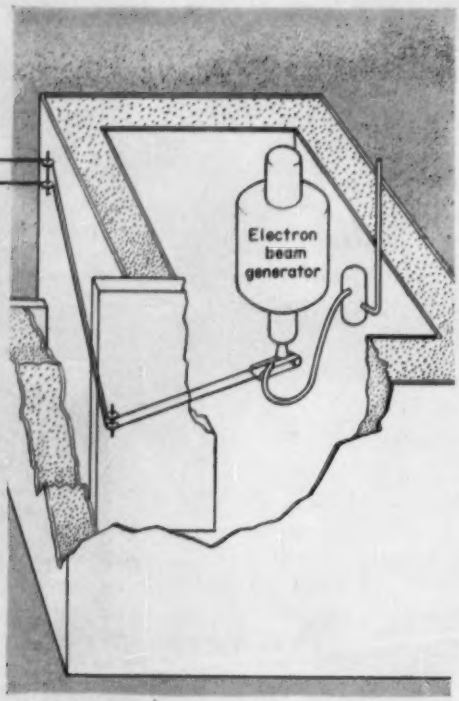
Wire coated with modified polyethylene, after irradiation, can take temperatures up to 480 F.



Modified Formulation + Irradiation Yields . . .

New High-Temperature Polyethylene

A NEW commercially produced irradiated polyethylene can withstand continuous temperatures of 300 F. and will resist brief exposure to temperatures as high as 480 F. These temperature limitations are appreciably higher than those reported for previously available forms of polyethylene —regular or linear (Ziegler), plain or irradiated (*see cuts on p. 124*).

Called Hyrad, the new material is now used on coated wire produced by Sequoia Process Corp. at Redwood City, Calif.

▶ **Modified Formulation**—During its development (begun less than two years ago) via a joint Sequoia-Stanford Research Institute project, some 10,000 formulations of both regular and linear polyethylene were screened, so that polyethylene structure can now be effectively modified through a "simple" processing step. Unwilling to say more about the modification,* Sequoia accomplishes the radiation with a General Electric 1-mev., 1-milliamp. electron beam generator which can process up to 30,000 ft./hr. of wire.

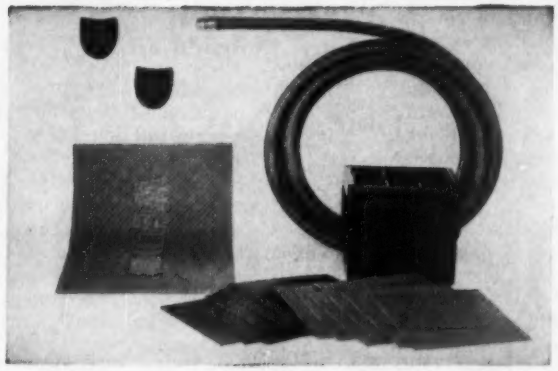
Approximating Du Pont's Teflon-coated wire in many characteristics, Hyrad-coated wire sells for about half the price, should be much cheaper once large-volume production begins. Du Pont is said to be negotiating a licensing arrangement with Sequoia whereby the former would have the right to make Hyrad; Sequoia would stay in the picture, at least through a continuing development program.

▶ **Market Potential**—Because of its temperature resistance, markets are pretty certain for Hyrad on wire and cable in jet aircraft and in various electronic components. For extended periods, the new plastic is usable at 390 F. For brief periods, it can take temperatures high enough to accommodate iron or dip soldering; immersion briefly in molten solder at 480 F. does not do any harm to Hyrad.

Unlike conventional polyethylenes, Hyrad does not crack when stress is relieved after being applied for long periods. Also, the internal stress usually created in other dielectrics during molding or forming is absent. As a result, there is no

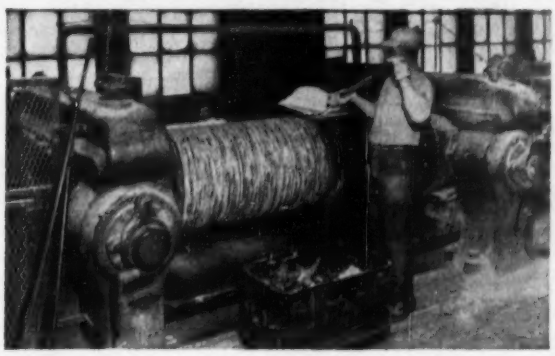
* Other polyethylene formulations incorporate various waxes, resins or elastomers as modifiers.

New polymer offers rubber industry important improvements



Properties of A-C* Polyethylene – Tests in laboratories and by commercial operators show that low-molecular-weight, low-viscosity A-C Polyethylene has solved many problems in rubber processing. A-C Polyethylene, available in pellet and powder form, is easy to handle in your plant equipment. Emulsifiable grades are also available.

Shrinkage Greatly Reduced – Addition of A-C Polyethylene to milled stocks can sharply reduce shrinkage, permitting adherence to closer dimensional tolerances. In one case, shrinkage of a synthetic formulation was reduced by 75%.



Excellent Detackifying Properties – A-C Polyethylene is a superior detackifying agent, especially at elevated Banbury, mill and calender temperatures of 200°F. and higher. This property is particularly valuable when compounding synthetics. It has demonstrated exceptional qualities as a mold release; as a lubricant it allows higher operational speeds.

Compatible with Natural and Synthetic Elastomers Reports from commercial users indicate that up to 25 parts of A-C Polyethylene per 100 parts elastomer can be used with no indication of incompatibility. A-C Polyethylene-elastomer blends have possible interest where greater resistance to oils, solvents, acids and alkalies is required. It is often reported that gloss and scuff-resistance of the product are enhanced and color and filler dispersion are accelerated. A-C Polyethylene is giving the rubber industry new products and new qualities to familiar products. Try it today! Production quantities are readily available.

Information and Samples Available – Preliminary technical data is available in an eight-page brochure. Samples of A-C Polyethylene are also yours for the asking.

A-C* Polyethylene

*trade-mark

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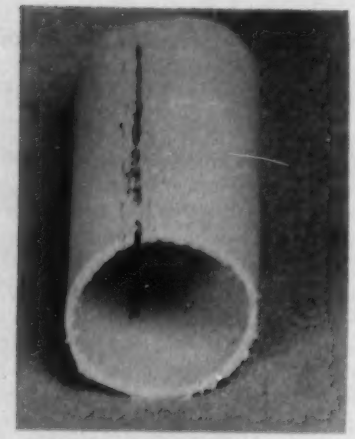
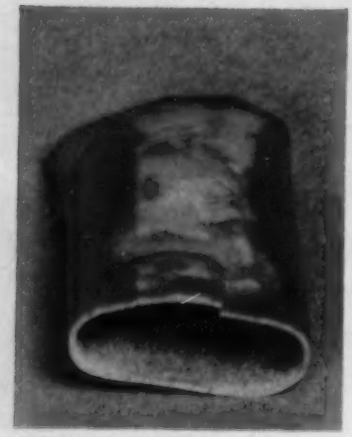
What 300 F. for 96 hours does to polyethylene



MODIFIED, IRRADIATED



NORMAL IRRADIATED

ORDINARY LINEAR TYPE

warping or shrinkage problem when the new polyethylene is exposed to heat.

The door is open to industrial uses, such as tubing for hot water, fluids and certain chemicals. Hyrad's elastic "memory" permits a tight shrink-fitting under considerable tension for insulating capacitors, lugs, splices and soldered joints. However because of this elastic memory, which it shares with unmodified polyethylene, it must be irradiated in final form.

▶ **Irradiation Process** — Sequoia's 1-mev. electron equipment penetrates only about ½ in., so higher voltages will be required for irradiation of heavier stock. But higher-voltage generators are becoming available, and gamma sources, such as cobalt-60 or X-ray machines, can also produce deeper penetration. There should be no difference between beta and gamma radiation as long as penetration is uniform through the plastic material.

The electron beam generator now used at Redwood City is housed behind thick, sand-filled protective walls. Current passing out of a tube is directed through a 2½-in.-dia. titanium window and spread out in a cone-shaped ionizing beam. Wire coated with the modified polyethylene passes under the beam on pulleys. Each segment of wire follows the same path through the beam intensity, thus receives identical amounts of radiation.

Hyrad's conversion to a heat-resisting state takes place through a cross-linking action. Thereby the hydrogen-carbon bond is broken by the removal of hydrogen atoms. Concurrently, the chemical structure breakdown through severing of the carbon-carbon bonds is averted.

Sequoia believes that Hyrad opens a whole unexplored field of research and development. Physical properties of the product can be controlled over a wide range by varying the starting material (pelletized regular or linear polyethylene), the modification steps and the amount of radiation. Sequoia's confidence can be judged by the fact that the company has ordered three improved 1-mev., 3-milliamp. electron beam generators.

Ethyl to Enter Vinyl Chloride Field

Ethyl Corp. plans its first production of vinyl chloride monomer at a multimillion-dollar plant to be built at the site of its antiknock compound plant at Baton Rouge, La. Completion is scheduled for late in 1957. The company also plans expansion of its tetraethyl lead facilities. For use as a possible plant site, land near Joliet, Ill., has been put under option.

New Way to Recover Chromic Acid Solutions

A new method for recovering contaminated or spent chromic acid solutions typical of chromium plating, anodizing and copper stripping operations has been developed by Mutual Chemical Div. of Allied Chemical & Dye. Metallic contaminants are removed by passing solutions through a cation exchange resin consisting of a sulfonated infusible polymer of a polyvinyl aryl compound.

In large-scale operations, the method not only decreases cost of chromium chemical treatments but reduces cost of waste treatment necessitated by increasing emphasis on eliminating stream pollution. Further, it has been reported that the quality of plated and anodized work is improved by the use of the decationized solutions.

Three Moves in Western Phosphates

Three firms have been active this month in the Western phosphates picture: Potash Co. of America has projected construction of either a concentrated superphosphate or an elemental phosphorus plant in southern Idaho or northern Utah. Central Farmers Fertilizer Co., Chicago, has called for construction bids on a $5-million elemental phosphorus furnace and rock bene-

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ficiation plant to be erected near Georgetown, Idaho. San Francisco Chemical Corp., Montpelier, Idaho, major Western miner of phosphatic shales, has acquired 3,000 acres of phosphate reserves near Vernal in eastern Utah.

San Francisco Chemical's acquisition was from Humphreys Phosphate Co. of Vernal, which controls reserves estimated at 1 billion tons, out of the 2.5-billion-ton total reserves in the area. A principal problem in economic development of these phosphatic reserves is transportation to the Utah and Idaho chemical centers, which would use the material either in production of concentrated superphosphate through the acid method or other phosphatic products through electric furnaces.

While there are plans, as a part of the Upper Colorado River Basin project, to bring new sources of power into the Uintah Basin of Utah and Colorado, it would be some years before the energy was available.

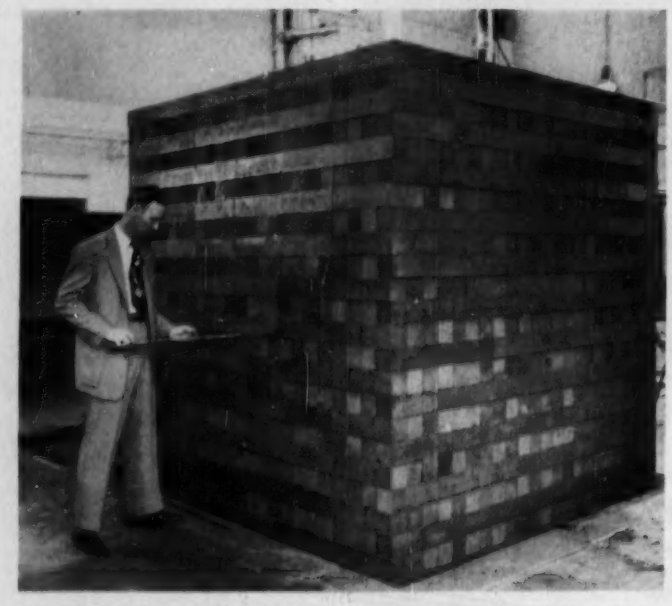
Atoms Vulcanize Silicone Faster, Better

Speed, better product, ease and precision of control are advantages seen by Western Electric Co. in its new atomic technique for vulcanizing silicone rubber.

The process beams 2-million-volt electrons from a standard electrostatic gun at silicon gum. Conversion to silicone rubber takes place in 2 sec., compared with several hours for conventional vulcanizing methods.

All the good features of chemical vulcanization are said to be duplicated. The new technique avoids introducing chemical agents which remain in the rubber and spoil such desirable properties as those required for electrical insulation.

Control of the process consists merely of regulating the voltage (which controls speed of the electrons) and of governing the length of time of exposure to the radiation.



Graphite from First Nuclear Reactor Gets New Use

By measuring the amount of induced radiation in indium foils placed in the new subcritical reactor above, Argonne National Laboratory is getting data needed for the design of full-scale reactors. Uranium and graphite used in the 8-ft. cube were salvaged from the world's first nuclear reactor used by Enrico Fermi at the University of Chicago. Present unit contains 30 tons of graphite, into which 2¼ tons of uranium has been placed in accordance with a predetermined lattice-type arrangement. The original reactor, after its initial operation at the university, was dismantled and reassembled at a remote site southwest of Chicago. In 1955, it was again dismantled.

Convention Calendar

American Soybean Assn. and National Soybean Processors Assn., joint annual meetings, University of Illinois, Urbana, Aug. 12-15.

Combustion Institute, Sixth International Symposium on Combustion, Yale University, New Haven, Conn., Aug. 19-24.

American Institute of Chemical Engineers, national meeting, including symposia on "Mixing" and "Unit Operations in Nuclear Engineering," William Penn Hotel, Pittsburgh, Pa., Sept. 9-12.

New York University, second annual titanium lecture program, University Heights, New York, Sept. 10-14.

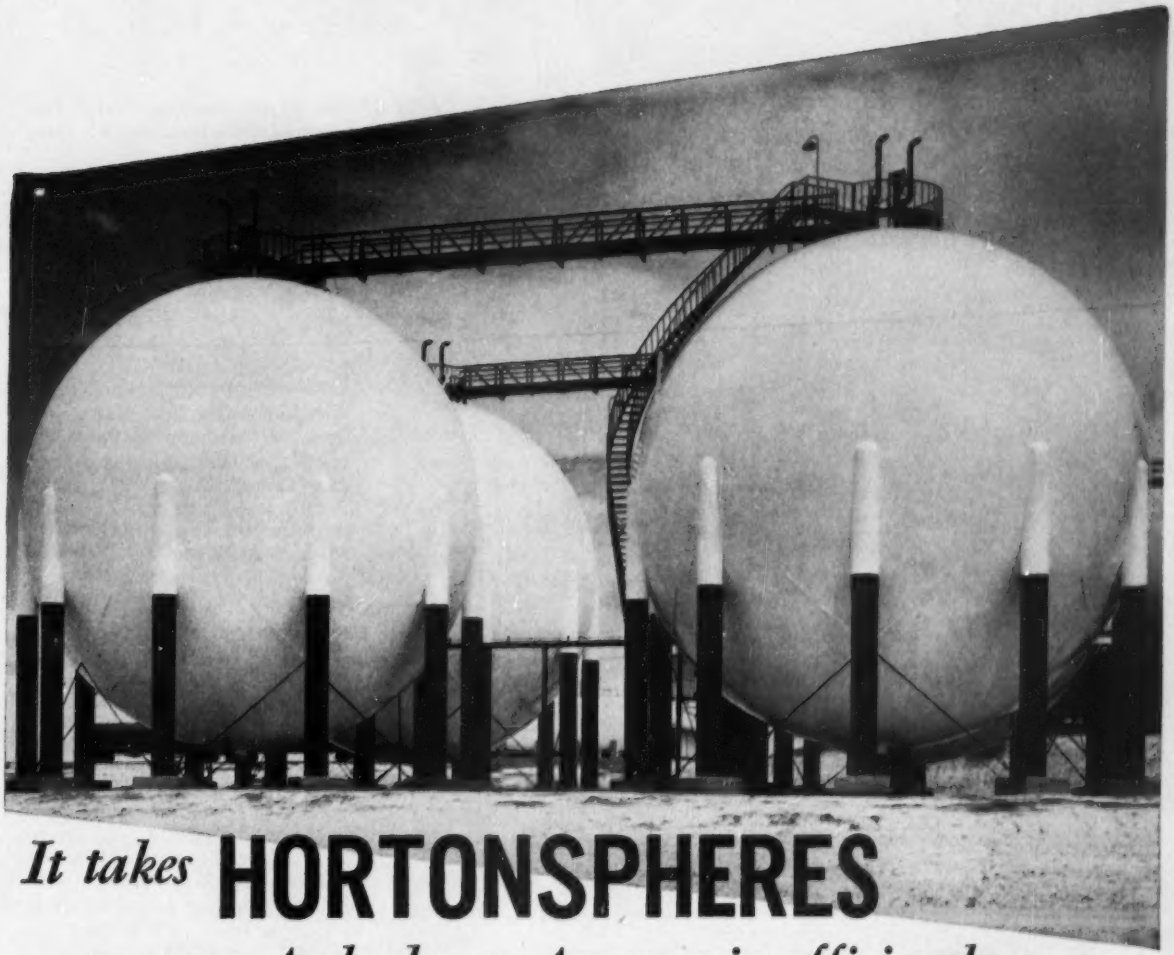
American Assn. of Textile Chemists and Colorists, Perkin Centennial, Waldorf-Astoria Hotel, New York, Sept. 10-14.

Instrument Society of America, 11th annual instrument-automation conference and exhibit, Coliseum, New York, Sept. 17-21.

American Oil Chemists' Society, 30th fall meeting, Sherman Hotel, Chicago, Sept. 24-26.

Atomic Industrial Forum, 1956 Trade Fair of the Atomic Industry and annual fall meeting, Navy Pier and Morrison Hotel, Chicago, Sept. 24-28.

American Institute of Mining, Metallurgical, and Petroleum Engineers, annual fall meeting of the Institute of Metals division, symposia on nuclear metallurgy and titanium, Hotel Carter, Cleveland, Oct. 8-10.



It takes HORTONSPHERES

to store Anhydrous Ammonia efficiently

Anhydrous ammonia, a highly volatile liquid, must be stored under pressure to prevent its loss to the atmosphere. The Hortonsphere® is a *pressure vessel* designed, engineered and built for the storage of such volatile liquids.

The four 15,000-bbl. Hortonspheres shown above are used to store anhydrous ammonia at the Lion Oil Company's El Dorado, Arkansas, chemical plant. The stored ammonia is refrigerated to about 50° F. to maintain a working pressure in the Hortonsphere less than 75 lbs. per sq. in.

Hortonspheres are built in sizes to 30,000 bbls. and for pressures up to 217 lbs. per sq. in. in the smaller sizes. Write our nearest office for further information.

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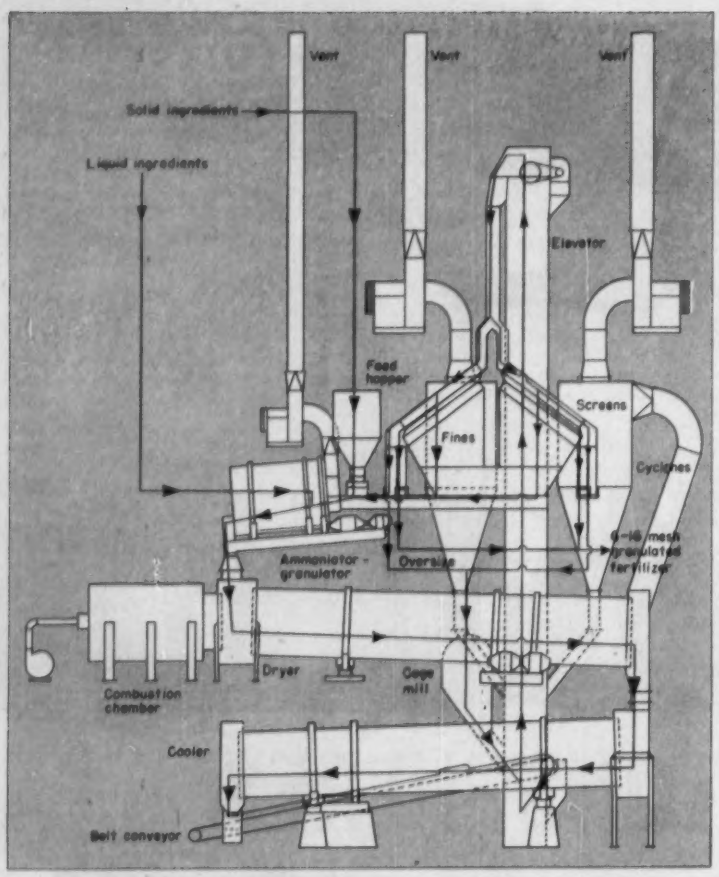

ASTUTE engineering of plant and process for granulated fertilizers . . .

Wins Over Economic Odds

Fundamental approach to design of fertilizer granulation process yields high unit capacity, sparks growing business for young firm in declining market.

While many segments of the economy are feeling the effects of declining farm income, business is booming for D. M. Weatherly Co., engineers and builders of fertilizer granulation plants.

In the brief space of time since starting up its first installation early last year, this wide-awake young organization has put ten plants into operation and has three more on order. Owner-engineer Dave Weatherly hopes to handle $1 million worth of business this year, laments the fact that inability to staff his Atlanta offices with additional engineers limits his ability to take on still more contracts.

▶ **Keys to Success**—What accounts for Weatherly's success under seemingly unfavorable economic conditions?

For one thing, competition among fertilizer producers for the farmer's hard-to-get fertilizer dollar is hastening the trend towards greater production of complete, granular fertilizers, with their better sales appeal.

Many producers have been resisting this trend, and for an understandable reason—they've been reluctant to sink money into the extra equipment required. This leads to the second factor accounting for Weatherly's land-office business.

▶ **Better Mousetrap**—Compared with other granulation plants, Weatherly-designed plants can turn out as much as twice the production with the same size of equipment.

This is not just an idle advertising claim. It is confirmed by trade reports and supported by published descriptions of other plants.

Typical cost of a Weatherly granulation plant for a capacity of 40 tons/hr. is about $225,000-250,000. This plant would include a 7x12-ft. ammoniator-granulator, an 8x40-ft. rotary dryer and an 8x50-ft. rotary cooler. The accompanying photographs are from a plant of this capacity furnished to Kingsbury & Co., Peru, Ind.; it started up in February of this year.

For smaller producers who can gear their output closely to market demand, Weatherly builds a 20-ton/hr. unit at a cost of about $75,000 (of which about $55,000 represents cost of the equipment). Low cost of this unit reflects the absence of the dryer from the flowsheet. This means, however, that the product has a limited storage life, either in bulk or in bags.

▶ **Fundamental Approach**—Weatherly granulation plants react sulfuric acid with ammonia and/or ammoniating solution simultaneously with ammoniation of the superphosphate. Heat of reaction drives off approximately half the moisture* and promotes the formation of granules as the ammoniating drum rotates on its horizontal axis.

Although this idea is not unique, Dave Weatherly—drawing on his chemical engineering training and experience—has made a thorough, fundamental process-engineering study of it

* Moisture content of solids from the ammoniator runs 4-7%, vs. the 10-12% obtained in conventional ammoniation processes.

NH_3

3 more ammonia plants by Foster Wheeler

Three major petrochemical manufacturing companies have recently authorized Foster Wheeler to proceed with the design and construction of three Ammonia Synthesis Plants having a combined NH_3 production capacity of 585 tons/day. One of these plants will have a design capacity of 305 tons/day, the largest ever built by Foster Wheeler.

Hydrogen, for all three plants, will be separated from hydrogen-rich tail gas streams from nearby processing units.

These contracts reflect industry's approval of the Casale Process for Ammonia Synthesis and also Foster Wheeler's design, engineering and construction "know how". When these plants are completed, Foster Wheeler will have built —

9 NH_3 Synthesis plants with a combined capacity of **1585 T/D**

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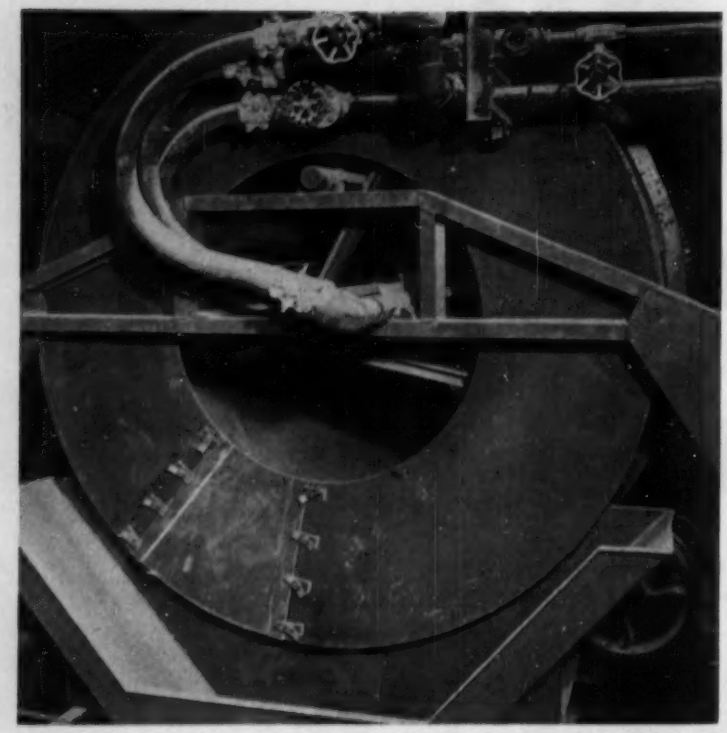
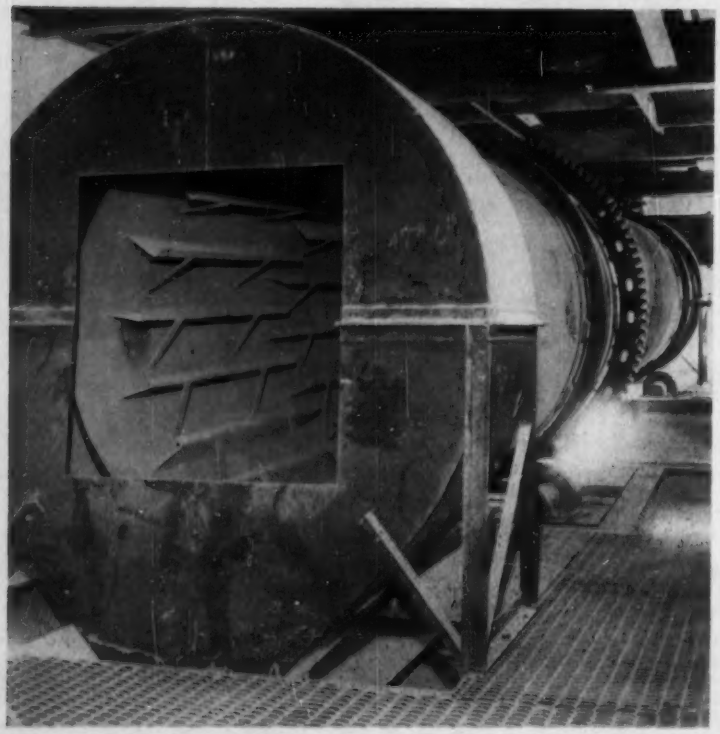


LIQUID ingredients enter ammoniator-granulator through these pipes.



ROTARY DRYER performance reflects low moisture content of feed.

in order to maximize its value. He has developed fundamental relationships involving heat balance, moisture content and the solubilities of the various types of salts present in the system.

In practice, these variables can be controlled conveniently by controlling the temperature in the ammoniator. For the more common fertilizer analyses, the control point is in the 220-230 F. range.

▶ **Full-Scale Proof**—For any departure from common practice, Weatherly checks out his calculations and establishes optimum operating conditions via tests in a full-scale prototype unit. Such a program will be followed if, for example, Weatherly is asked to design a granulation plant using phosphoric acid instead of sulfuric.

In addition, Weatherly persuades his clients to sign up for a one-year retainer when they contract for a plant. This gives the client the opportunity to call for Weatherly's assistance with any operating problems during the first year of operation.

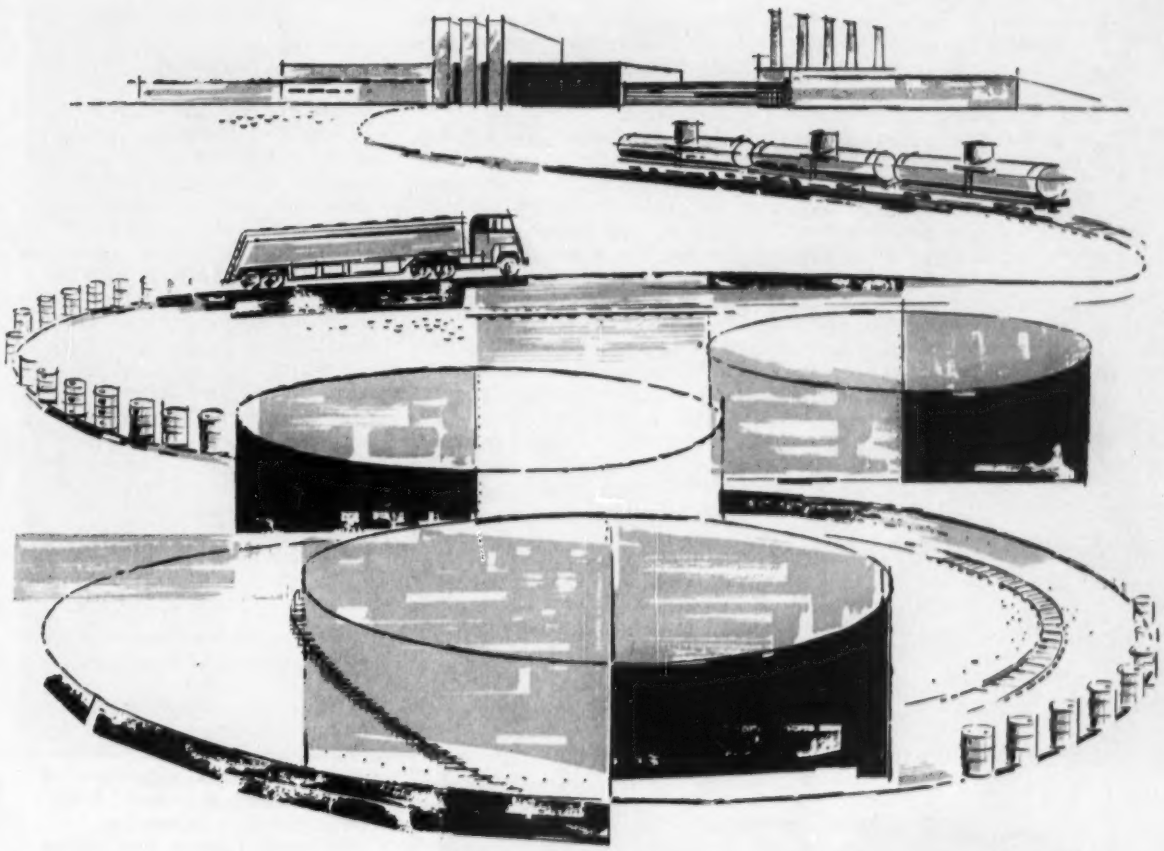
▶ **Process Description** — The Kingsbury installation forms the basis for the following description of the process:

Solid raw materials are weighed, premixed and placed in a surge hopper. Beneath the surge hopper is a continuous weigh feeder which can be set for the desired rate of production.

The metered solid materials are fed continuously into the ammoniator, along with the liquids (sulfuric acid, anhydrous ammonia and/or nitrogen solution). It's in the ammoniator that the chemical reactions take place and granulation results.

Granulated fertilizer from the ammoniator goes to the rotary dryer, which operates with feed and hot gases in parallel flow. Dryer is fired with natural gas. Dry product drops into a countercurrent rotary cooler.

▶ **Finishing Steps**—After cooling, the product is carried via bucket elevator to the classification stage of the process. A pair of two-surfaced vibrating



Now! Large Phenol, U.S.P. storage facilities near principal consuming points

To better serve Eastern and Midwestern Phenol users, Oronite has established bulk distribution terminals at key consuming points. This means large quantities of Phenol, U.S.P. in tank car, tank truck and drum shipments are quickly available from Oronite.

Why not get further information on Oronite's new Phenol distribution setup. Just contact the Oronite office nearest you.

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screens size the product, with a 6x16-mesh cut delivered to storage by belt conveyors.

Oversize is carried to a cage mill for cracking and rescreening. Fines return to the ammoniator for granulation along with fresh feed.

Dust losses from the dryer and cooler are minimized by collecting the fines in cyclones and returning to the process.

Mounted on a panelboard are the necessary recording, controlling and integrating instruments. All the pushbuttons for operating the equipment in the granulating unit are also located on the instrument panel.

GE, AEC Revise Hanford Contract

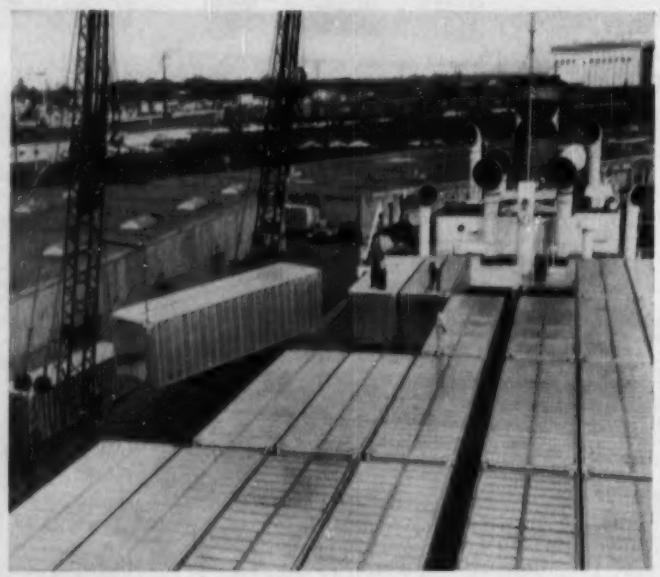
General Electric Co. will be paid $2.65 million per year to operate the Hanford, Wash., plutonium plant and the Knolls Atomic Power Laboratory at Schenectady, N. Y., under a revised contract with the Atomic Energy Commission.

Since September 1946, GE has received a token fee of only $1 per year for managing the Hanford project, although the government has reimbursed the company for a $97,000 monthly administration expense. Under the new contract's terms, the company will absorb some indirect and overhead expenses previously reimbursed and will assume certain liabilities formerly carried by the government.

Among the technical advances made during GE's tenure at Hanford have been: Perfection of a large-scale, continuous-flow chemical separations plant for irradiated fuel; improved methods of radioactive waste disposal (*Chem. Eng.*, Nov. 1955, p. 138); new devices for handling radioactive materials for measuring radiation.

A newly revealed development involves a unique and safe way of examining the crystalline structure of wafer-like samples of irradiated uranium. Slices of uranium are cut from irradiated slugs and polished inside huge multicurie cells. To shield workers against beta and gamma rays, cells are insulated with 10½ in. of steel and they have windows of a special lead glass composition.

The polished uranium wafer is then placed in an evacuated chamber, where its crystalline structure is etched out by an electrical process. Finally, the prepared uranium surface is photographed inside the cell by a remote metallograph, a combination microscope-camera.



Detachable Vans Merge Sea and Land Transport

Detachable truck bodies which can travel both by land and by sea are the core of a new Sea-Land Service now offered by Pan Atlantic Steamship Co. to move freight between Newark, N. J., and Houston. Loaded 40,000-lb.-capacity vans are lifted from trucks' underpinnings and fitted aboard specially slotted cargo decks. Two 58-van ships are now in weekly operation; seven more are planned. Highway trailers formed when van is coupled for land movement are of standard size.

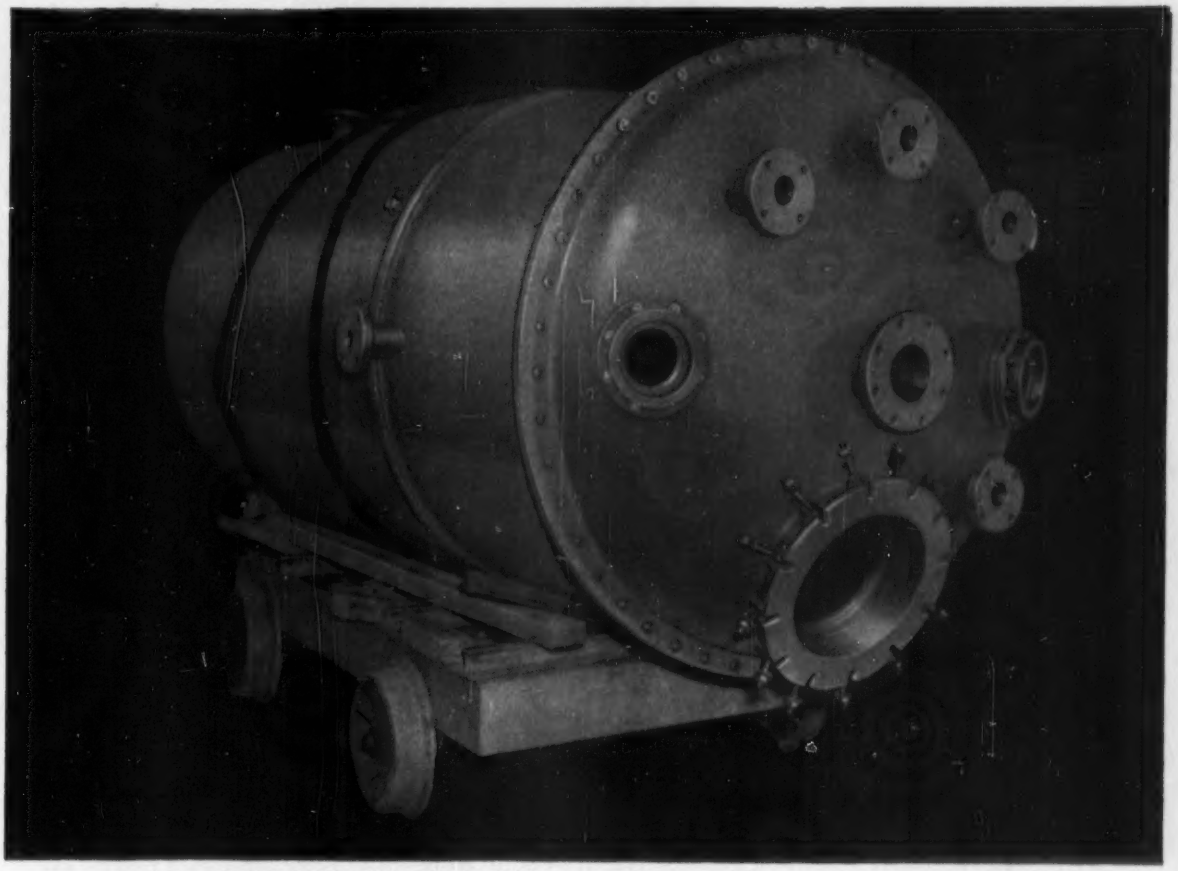
New Petrochemicals Units For Japan and Britain

Work has started on an $8-million expansion of the Partington, England, plant of Petrochemical Ltd., a subsidiary of Shell Chemical. And Mitsui Petrochemical Industries, Ltd., will build Japan's first major petrochemical project, a $30-million facility for the production of chemical intermediates.

New facilities at Partington will include a 25,000-ton/yr. ethylene oxide plant, which is about double the capacity of an existing unit at the site. Shell Development's process for direct catalytic oxidation of ethylene will be used.

A new plant for the conversion of ethylene oxide to ethanolamine came into operation last January, and additional capacity for glycol ethers, polyglycols and nonionic surface-active agents is now being built. On completion of the direct oxidation plant, the existing ethylene oxide plant will be used to expand present production of propylene oxide.

For the Japanese company, Scientific Design Co., New York, will design and engineer plants for the manufacture of ethylene oxide (also by direct oxidation), ethylene glycol and cumene. Later, Mitsui will add facilities for the production of dimethyl terephthalate.



Steel Steam-jacketed Still with bonded lead lining. This unit, placed on side for transport through plant, is five feet I D by eleven feet deep. All surfaces exposed to corrosion carry a ¼" lead lining bonded to the steel by National Lead's unique, improved process.

National Lead weds lead to steel

. . . boosts life of lead-lined vessels

Lead-steel bonds in lead-lined equipment have never been as satisfactory as they are today . . . thanks to the improved process by which National Lead *weds* lead to steel.

Mechanical abuse – impact, crushing, twisting – does not destroy the bond. "Torture tests," designed to pry the lead from the steel, do not separate the metals at the interface . . . the union is stronger than the tensile strength of lead.

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With the improved bonding method you get the kind of lining performance in massive vessels that you get from National Lead "Tubond" pipe and "United" valves. Pressure, vacuum, vibration and heat (short of lead's melting point) don't disturb the lead-steel bond. Blistering, buckling and cracking are virtually eliminated even under severe and rapid cyclic temperature changes.

If your processing employs corrosives, National Lead fabricated vessels can bring you major savings in maintenance costs and cut losses due to production stoppages.

National Lead makes lead-lined equipment of all types and sizes, from small-bore "Tubond" pipe to tank cars and beyond. Write for quotations on any acid-handling equipment you have in prospect, furnishing, if possible, sketches or prints, and information on type of corrosive, flow factors, temperatures, pressures and other operating data. Address National Lead Company, Lead-Lined Dept., 111 Broadway, New York 6, N. Y.

National Lead Process Vessels

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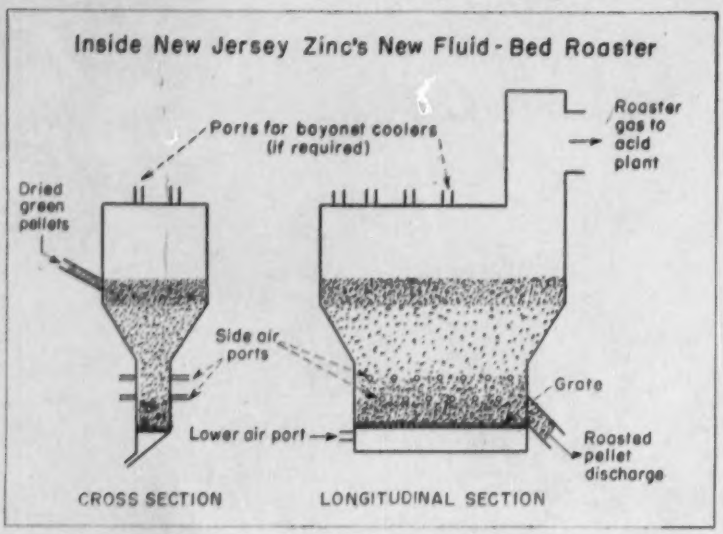


Air Jets Control Fluid Bed

Rectangular fluid-bed roaster features four zones of differing bed density and turbulence, achieving stage-wise operation without the use of grates.

Breaking sharply with precedent in fluid-bed technology, New Jersey Zinc Co. has snared the highly prized characteristics of multistage operation in a novel fluid-bed roaster for processing zinc concentrates.

Constructionwise, highlight of the new roaster is its long, narrow, rectangular cross-section, rather than the circular cross-section of conventional fluid-bed units.

Operationwise, the new roaster's outstanding feature is the vertical staging of four fluid beds—accomplished without intermediate grates or other mechanical separation.

▶ **In Commercial Use**—New Jersey Zinc put up a prototype commercial-size unit at Palmerton, Pa., in 1953, scaled up from earlier pilot-plant models. It had a capacity of as much as 90 tons/day of zinc concentrate.

Cerro de Pasco Corp., La Oroya, Peru, soon followed with a unit designed for bona fide commercial operation. When building a new electrothermic zinc smelting plant in 1953, Cerro bought New Jersey's Peruvian patents and installed a 100-ton/day fluid roaster based on the Palmerton design.* The company is now building a new fluid-bed unit of larger capacity —one which will produce calcine for both electrolytic and electrothermic zinc operations.

New Jersey has not carried commercialization of the roaster further in its own operations. Demonstrated cost advantages aren't sufficient to justify scrapping existing roasting and sintering facilities, say company engineers. Expected field of application, rather, is in new plants.

For a new installation, the four-stage fluid-bed roaster is as cheap to install and operate as hearth and flash roasters. And new plants should be able to develop cost-cutting economies with further operating experience and development work.

▶ **Air Velocity Controls Stages**—Fluidization stages are defined by changes in bed density from bottom to top of the unit.

Lowest stage is a relatively dense bed. It is supported by a grate and fluidized by a relatively low-velocity air stream.

As this air moves upward, it is joined by an air stream introduced through a multiplicity of ports at a level several inches above the bottom grate (*see cut*). The increased gas velocity boosts the turbulence of the second bed in this zone. This process is repeated to create the third bed with the introduction of still more air at a higher level. Gas velocity and bed turbulence are compounded by the increasing temperature of the gas as oxidation of the zinc sulfide occurs in the roasting process.

Above this third bed the cross-section of the roaster nearly doubles, dropping the velocity of the rising gas stream, thus reducing the bed turbulence and increasing the density of the fourth, uppermost stage.

▶ **Rectangular Shape**—To put these principles to practical use, N. J. Zinc's engineers had to scrap the conventional cylindrical fluid-bed design. Instead, they came up with a rectangular shape, which design greatly simplifies the problem of uniform distribution of air at the second and third levels.

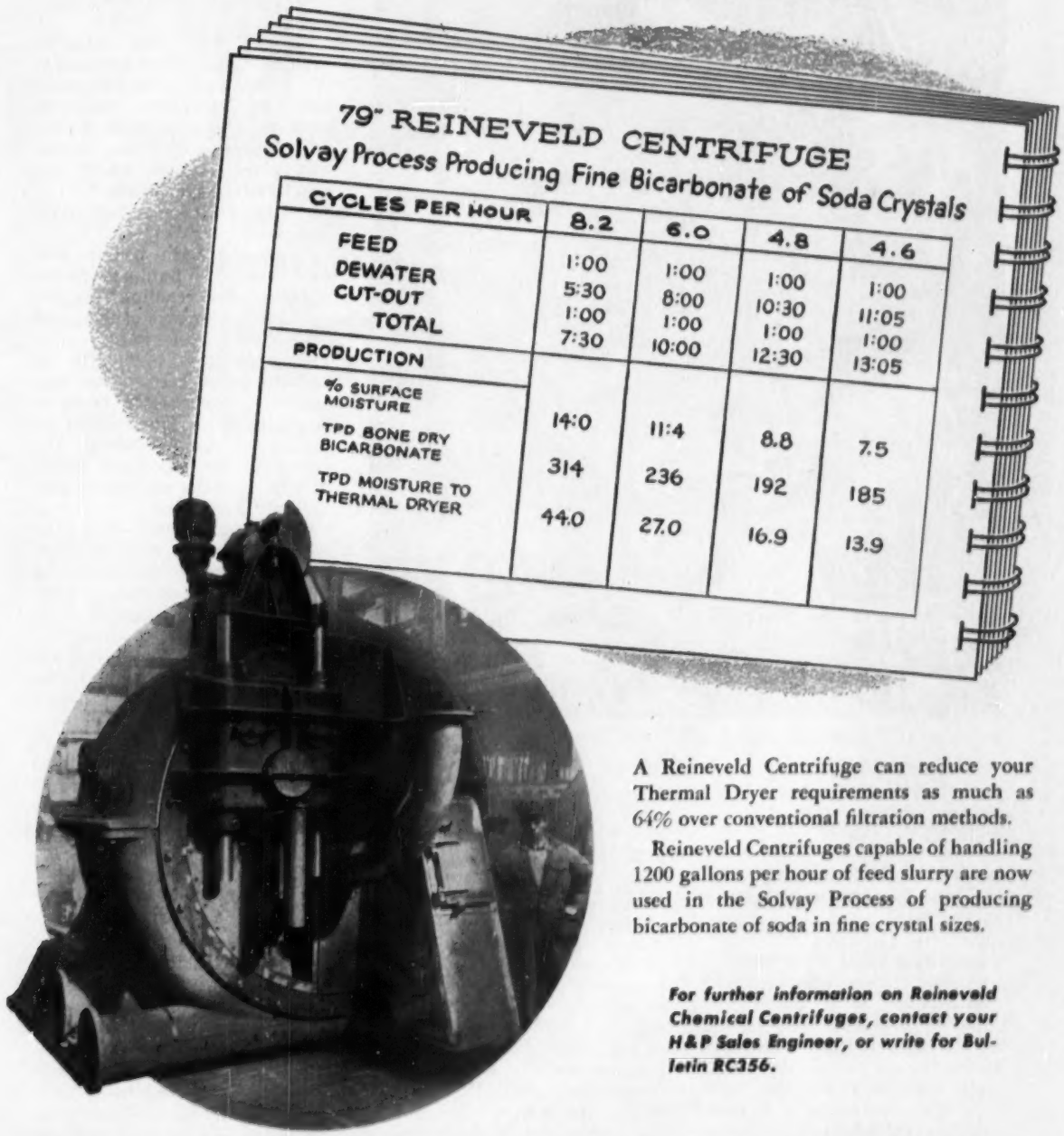
The Palmerton unit is 10 ft. long by 2½ ft. wide at the hearth level, expanding to 4 ft. wide in the upper section. Cerro de Pasco's roaster is the same width but is 16 ft. long.

▶ **Pelletized Solids**—Another break with precedent is the use of pelletized solids in the fluidization process. This technique permits high gas velocities (and high bed turbulence) without excessive dust losses.

With a feed to the roaster consisting of dried pellets in the range of 4 to 20 mesh, dust carryover is held to 10-15%. This is recovered in a cyclone and electrostatic precipitator. And, says N. J. Zinc, this

* Numerous modifications were necessary, however, to meet the rarified atmospheric conditions (elevation: 12,-200 ft.) at La Oroya.

Out of the Engineer's Workbook...



A Reineveld Centrifuge can reduce your Thermal Dryer requirements as much as 64% over conventional filtration methods.

Reineveld Centrifuges capable of handling 1200 gallons per hour of feed slurry are now used in the Solvay Process of producing bicarbonate of soda in fine crystal sizes.

For further information on Reineveld Chemical Centrifuges, contact your H&P Sales Engineer, or write for Bulletin RC356.

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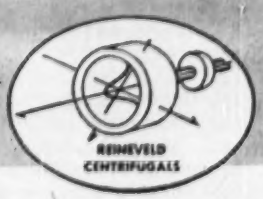

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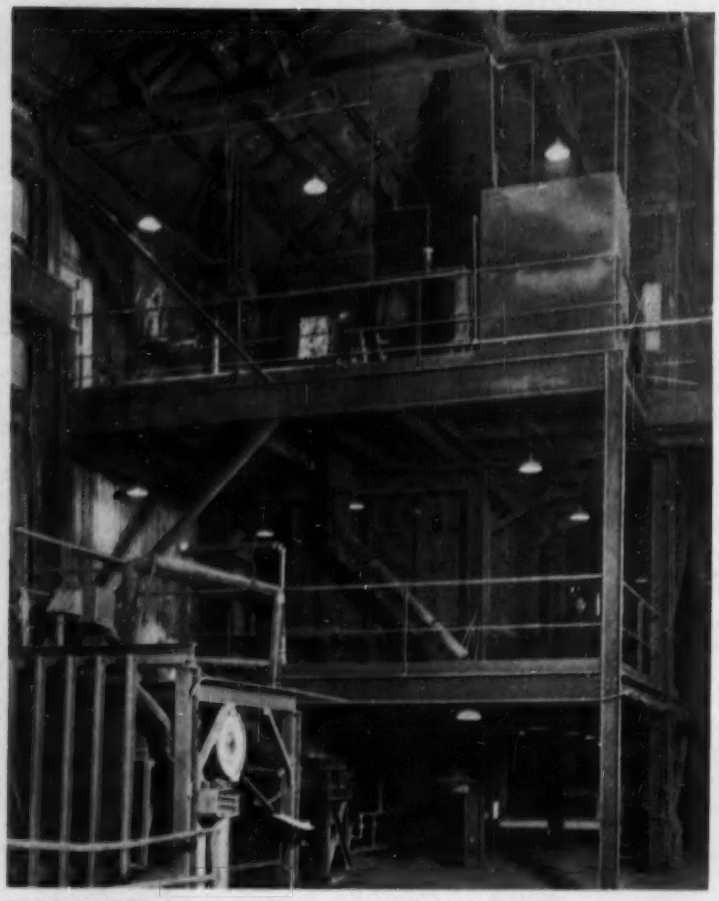

FULL-SCALE prototype proved workability of new fluidization scheme.

amount of dust, sulfated by the addition of sulfuric acid, constitutes a proper amount of binder in the pelletizing step. Cerro de Pasco does essentially the same thing, pelletizing its marmatite (50% Zn, 13% FeS_2) concentrate with zinc sulfate, produced from roaster fines and sulfuric acid, as the binder.

In its development program New Jersey studied bentonite, sulfite liquor, sodium sulfate as well; discovered also that certain zinc concentrates contain sufficient soluble salts to permit pelletizing without the addition of a binder.

▶ **Roasting Process**—Pellets of zinc concentrate, dried but "green," enter the N. J. Zinc roaster via side ports located in the expanded section of the unit. Here the pellets are preheated, picking up heat from the gaseous roasting products. They also help trap out any dust rising through the unit.

Most of the roasting takes place in the two turbulent zones, is completed in the relatively quiescent lower zone. Any entrained sulfur dioxide in the discharging calcine is swept out here by the small air stream. Product runs as low as 0.25% in sulfide sulfur.

A number of bayonet coolers, using water as coolant, provide temperature control of the bed at high throughput. The coolers are inserted in the bed through ports in the roof. Optimum temperature has been determined to be just below the sintering point of the concentrates (950-1,150 C.). New Jersey finds that by keeping water out of the bed, corrosion in the waste-heat boiler and other gas-treating equipment is eliminated.

▶ **Selling Points**—The combination of multistage operation and pelletized feed yields the following significant advantages over conventional fluid-bed practice:

- Unit has high capacity with minimum short-circuiting.
- Calcine is directly available in reducible, pelletized form without sintering. Elimination of the sintering operation gives savings which are practically clear "gravy."
- As pointed out above, dust losses are low.

Compared with hearth and flash roasters, fluid-bed roasting offers fast reaction time, excellent temperature control and distribution in a compact, simply constructed unit with no moving parts. Installation and operating costs match those of flash roasters. Elimination of the need for grinding the charge is an important factor in offsetting the expense of pelletizing the charge.

▶ **Other Applications**—N. J. Zinc believes that its new fluid-bed zinc roaster is applicable to other materials as well. Experimental work on a limited scale has demonstrated applicability to pyrrhotite (FeS) concentrates. And pyrite (FeS_2) has also attracted interest, though certain engineering modifications would be necessary to adapt the Palmerton design to this material.

Cyanamid Plans Include Aniline Via New Process

American Cyanamid's new plant plans include: Commercial christening of fluid-bed production of aniline at Willow Island, W. Va., with a 24-milion-lb./yr. unit; doubling acrylonitrile production at its existing $50-million plant at Fortier, La.

The Willow Island plant, to be completed late in 1957, will use for the first time a fluid-bed reactor and new catalyst in the manufacture of aniline from nitrobenzene.

Doubling of the acrylonitrile capacity will entail duplication of units for making oxygen, acetylene and hydrogen cyanide. These are part of a $39-million over-all expansion at Fortier, to

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International's MgO is now available in the highest purities ever produced commercially in carload quantities. It is made in grades with low iron, low boron, low lime, low ignition loss.

With a dependable supply of high purity MgO assured by *International*, many industries are using this material for new applications or as a replacement where the product offers certain advantages based on purity.

✓ **EXAMPLE: As An Alkali Precipitant.** MgO is used in uranium ore processing for precipitation of concentrates through a gradual increase in pH from high acidity to neutrality to maximize crystal growth, achieving higher filtration rate, higher washing rate, higher purity of product. Incremental additions of strong bases, use of elevated temperatures or flocculating agents can be eliminated. Available MgO for neutralization—99.0% minimum.

✓ **EXAMPLE: As A Stabilizing Agent in Plastics.** Because of its good dielectic properties, MgO may be useful as a stabilizing agent for vinyls for standard electric insulation stocks.

✓ **EXAMPLE: For Ceramics and Special Refractories.** X-ray diffraction patterns indicate International MgO is in the form of micro-crystalline periclase. Material is burned at relatively high temperatures (2900°F). Iron and lime contents are remarkably low. MgO with these characteristics may be of special interest for new applications.

✓ **EXAMPLE: As An Extender For Other Magnesias.** High purity MgO offers certain advantages for mixing with other high or low valued magnesium oxides.

✓ **EXAMPLE: As A Furnace Feed For Special Fused Refractories.** Pure MgO basic refractories and other fused refractories in which chrome or other constituents are added are being produced with International's low iron, low lime material.

✓ **EXAMPLE: Filter-aids for Special Applications.** High purity MgO is suggested for use in filtrations to remove finely divided solids from caustic solutions. It is very stable in strong caustic solutions, contamination of the caustic is minimized and there is no danger of silica or iron contamination.

LET'S TALK ABOUT QUALITY

Look at this typical analysis of just one of our high purity grades.

MgO	–99.5	Al_2O_3	– 0.04
SiO_2	– 0.05	CaO	– 0.08
Fe_2O_3	– 0.06-0.08	Na+K	– 0.05

Boron Range—3 ppm to 25 ppm B

Powdered as fine as 90% minus 325 mesh

✓ **For your experiments, we will furnish adequate samples of International's MgO in a grade suitable to your needs if you will indicate your area of interest.**

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potash division

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be completed in 1958. Included will be facilities for making acrylonitrile derivatives. Already completed is a $4.5-million monomethyl styrene unit.

Starch-from-Protein Separation Made Sharper

Thanks to a new method of separation, residual protein content has been substantially cut in starch produced at National Starch Products' corn refinery at Indianapolis. Dorr Clone separators, getting their first full-scale use in starch refining, also permit a high degree of product cleanliness because the system can be completely enclosed and fully instrumented.

News Briefs

Resorcinol: Heyden Chemical Corp. will build a 3-million-lb./yr. resorcinol plant at Fords, N. J. It will be completed by the end of 1957, and production at the firm's existing resorcinol unit at Garfield, N. J., will be discontinued.

Atomic energy: AEC has selected the proposal of Babcock and Wilcox Co. to design, fabricate and operate a liquid metal-fueled reactor experiment. Union Carbide Nuclear Co. will be a major subcontractor, primarily in the chemical processing of fuel. As yet, no site has been selected for the project.

Vegetable oil: Honeymead Products Co., Mankato, Minn., is completing a vegetable oil extraction system said to be the largest of its type in the world. Facilities include a 31-ft.-dia. Blaw-Knox Rotocel extractor with a 1,200-ton/day soybean capacity.

Barium oxide: Current expansion at its Modesto, Calif., plant will increase Westvaco Mineral Products' production of barium oxide about 30%.

Polyethylene: Phillips Petroleum Co. has made Badische Anilin und Soda Fabrik exclusive licensee in Germany of its process for low-pressure polyethylene.

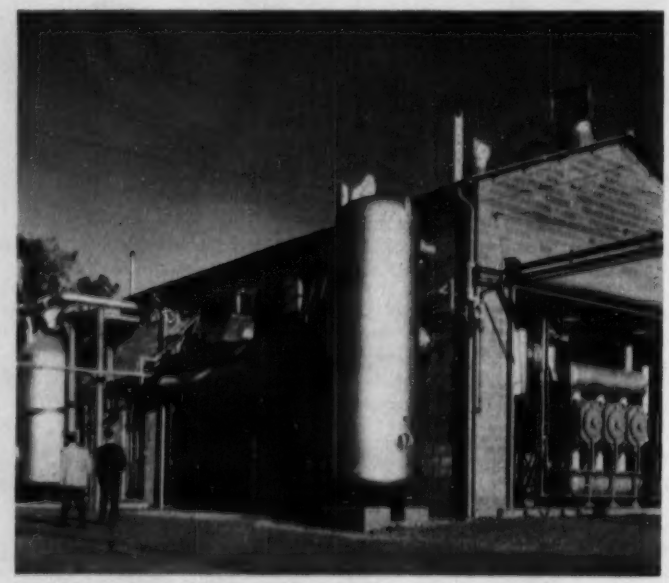
Herbicide: By 1957, facilities now under construction at North American Cyanamid's Niagara Falls, Ont., plant will triple production of amino triazole, a new herbicidal and defoliant chemical.

Methanol: Commercial Solvents plans to spend $10 million in the coming year to expand production of methanol and petrochemical derivatives at Sterlington, La., and Terre Haute, Ind., respectively.

Fungistat: A mixture of salts producing ammonia gas when moistened can be used as a fungistat in citrus shipments and it does not leave a residual odor. University of California's Citrus Experiment Station in Riverside, Calif., still conducting tests on the compound, sees it as a substitute for odor-producing biphenyl.

Phenol: B.A.-Shawinigan Ltd. is expanding its plant in Montreal East to increase the production of phenol by 50%.

Petrochemicals: Canadian Oil Cos. Ltd. will expand its petrochemical manufacturing facilities with a $3-million installation at its Sarnia refinery. New facilities will include the first Canadian plant for extraction of chemically pure benzene, toluene and xylene from petroleum.



New Jet-Fuel Combustion Lab for Full-Scale Tests

Texas Co. can make combustion studies over practically the entire range of conditions met in air-breathing jet-type power plants at its just-opened Beacon, N. Y., laboratory addition. The tall vessel at left, above, is a 3-million-Btu./hr. natural-gas-fired heater which preheats air to maximum of 800 F. Then air is fed to the combustion chamber of the test burner. Tower in the center is a surge tank for removing pulsations in the air flow from the 3-stage, 6-cylinder reciprocating compressor which can be seen through the open end of the building. Driven by a 1,000-hp. synchronous motor, the compressor is isolated from the building by supporting cork pads and from the piping through the use of accordion-like expansion joints.

Our Technical Service Laboratory Will Help You Build Better Products With Neville Resins

Neville Coumarone-Indene Resins have long been firmly established in the formulae for a wide range of products in the mastic floor tile, rubber, and paint industries and many others. They assist in the manufacture of better-looking, longer-wearing merchandise. Throughout the years, Neville has developed many variations of these versatile resins and has conducted constant research to adapt them to new employment. If your products are conceivably applicable, why not call upon our Technical Service Laboratory to assist your chemists in investigating their profitable use. Use the coupon below to write for further information.

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Please send further information on Neville Chemicals.

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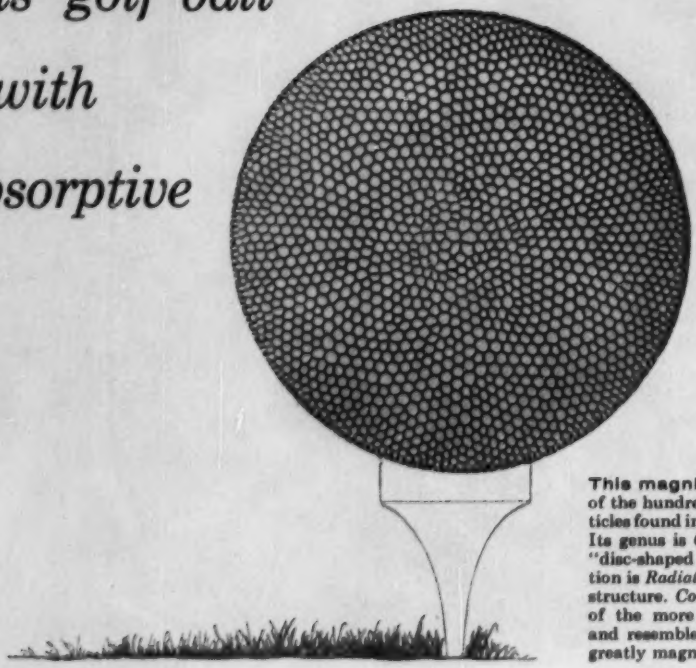
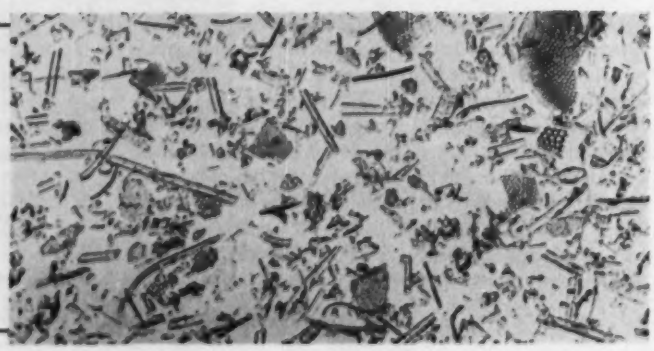
What's this "golf ball" got to do with greater absorptive capacity?



This magnification shows just one of the hundreds of different shaped particles found in Celite diatomaceous earth. Its genus is *Coscinodiscus* which means "disc-shaped sieve." Its species designation is *Radiatus* which refers to its radial structure. *Coscinodiscus Radiatus* is one of the more common marine diatoms and resembles a "golf ball" only when greatly magnified.

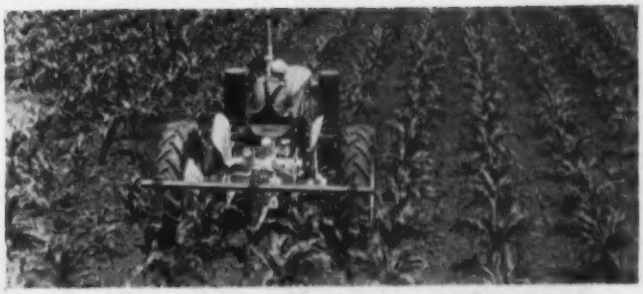
It's a particle of CELITE that absorbs more than

The secret of diatomite's remarkable properties is shown in this photomicrograph. The infinite variety of particle shapes and sizes gives Celite diatomite its exceptional performance characteristics in a wide range of process applications. The large percentage of voids both between and within particles like the "golf ball" provide porosity for high absorption.



Johns-Manville CELITE

Helps polishes soak up oil and dirt. In polishes for silver, other metals, glass and airplanes as well as automobiles, Celite absorbs residual oil, dirt and other solid matter. In addition, Celite imparts a delicate non-scratching polishing action.



Provides free-flowing fertilizers for uniform coverage. In ammonium nitrate fertilizers, highly absorbent Celite particles form a protective coating which helps prevent contact between crystal faces . . . thereby minimizing caking and assuring good flowability.

Controls viscosity in adhesives for corrugated paper. For precise control of viscosity and surface penetration, manufacturers of many types of adhesives rely on Celite's excellent absorptive capacity.

-the diatomite mineral filler twice its weight of liquid

Mix 100 cc of water with 100 grams of Celite* . . . the water is so completely absorbed that the mixture exhibits all the properties of a dry powder. This demonstration is visible proof of the high absorptive capacity of Celite diatomite fillers. Actually it will absorb 2 to 3 times its own weight before reaching its liquid holding limit. The reason is that approximately 93% of a given volume of Celite is composed of air spaces or voids. Despite its highly porous nature, however, Celite does not absorb moisture from the air.

In addition, Celite has many other unique properties which give it wide application as a mineral filler. Its high bulk—a cubic foot weighs only ten pounds—reduces outage in packaged powder products and provides the needed bulking action in many other formulations. The irregular shape of the particles and their hard silica structure adds reinforcing strength to paints and plastics. Other uses include concrete, insecticide diluent, paper and as a source of silica in "water glass" and "lime-silica" insulating materials.

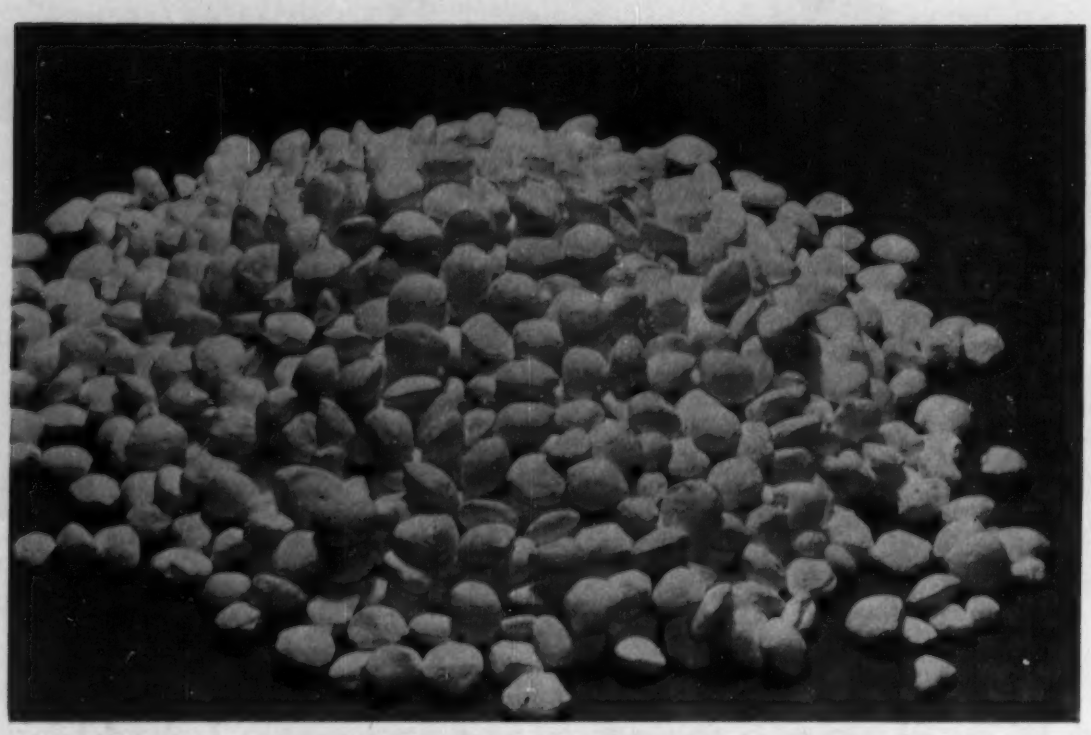
Produced from the world's purest commercially available diatomite deposit, Celite comes in a wide range of grades. Each grade is carefully controlled for complete uniformity.

Ask your nearest J-M Celite engineer to tell you how Celite can help solve your formulation problems. He's backed by Johns-Manville's extensive research facilities and years of practical diatomite experience. Call him today or write Johns-Manville, Box 60, New York 16, New York. In Canada, write Port Credit, Ontario.

*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

Industry's most versatile MINERAL FILLER

JOHNS MANVILLE JM PRODUCTS



MgO: First High-Purity Domestic Source

Thermal decomposition of $MgCl_2$ is now making available—in commercial quantities—an important chemical raw material in purities greater than 99.5%.

With the announcement of its recovery of HCl and MgO from waste magnesium chloride brine, International Minerals & Chemical Corp. has racked up two firsts for itself—a new process for producing MgO (see p. 346) and the only domestic source of 99.5% MgO in commercial quantities.

And now that 10,000 tons/yr. of this low-lime, low-silica, low-iron, low-boron magnesium oxide is available to the chemical process industries, many of them are eyeing the new source with a great deal more than routine interest.

▶**Advantage in Uranium Processing**—Already taking advantage of the high-grade oxide is the atomic energy field.

At a western uranium processing plant where uranium is recovered from ores via modified ion exchange process (resin-in-pulp), IMC's product is proving its worth in neutralizing acid solutions to provide controlled pH adjustment.

For unlike ammonia or other magnesium oxides which provide faster pH adjustment in the early stages of neutralization (but fine-grained, slow-filtering precipitates), purer MgO yields a larger-grained precipitate easy to filter and wash.

The success of this western operation is expected to open up other fields of use for IMC's MgO—where controlled pH adjustment in acid neutralization is a prime requisite.

Another atomic energy application of the new oxide depends, specifically, on its low boron content. During quality control in MgO processing, a selective grade of product containing less than 10 ppm. boron is set aside for another (undisclosed) AEC use.

▶**Others to Benefit, Too**—To traditional users of an imported magnesite for electrical insulation when fused and processed, IMC's product offers assurance of a constant domestic source of raw material for this use. Once International's product is thoroughly tested and adopted for this application, manufacturers won't be so totally dependent on overseas sources.

An extensive research pro-

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99.5% MgO in commercial quantities.....142A
Silicate binder 144A
Dacron-Hypalon cloth 144B
Polyurethane elastomer vies with rubber.146A
Source of PF_5 catalytic fluoride.....146B
Vinyl stabilizing system.....146C
New polyester-based film.....148A
Synthetic window panes.....148B
Lithium dispersions 148C
Pelletized styrene resin.....148D
Flake trimethylolpropane 150A
Synthetic waxes hike poly's rigidity.....150B
Anthraquinone vat dye.....150C
Sprayable plastisol 150D
Rare earth oxides and salts.....150E
Two new sulfonic acids.....150F
Anabolic drug rebuilds human tissue....150G
Lithium metal in 1-lb. ingots.....150H
Resin softener 150I
Vinyl toluene, oil-based paints.....150J

Page number is also Reader Service code number

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gram under International's sponsorship is being conducted to discover just how effective their product is as electrical insulation in heating elements for electric stoves.

Other fields being investigated include:

- Special refractories — Fused and others.
- Ceramics, special glasses and cermets—Products like high-temperature refractories for jet linings, heat-resistant glasses.
- Fine chemicals (reagent grade)—High-purity oxide is already being used, in limited quantities, to make other magnesium compounds, e.g., oxides, nitrate, sulfate.
- Extender—Because of its high purity, IMC's product can be used to extend high-valued magnesias, even light oxides, thus providing a high-purity blended product with attendant savings in cost.

▶**Seek New Uses**—Marketwise the new MgO is said to be competitive with other oxides (though there's a slight premium for purity).

At present two main physical forms are available—pellets (½-in. diameter, ½-in. thick) and powder. But International is eager and willing to explore any new end use with potential customers and will be glad to investigate how its product might possibly fit customer needs. — **International Minerals & Chemical Corp., Chicago 6, Ill.** 142A

For More Information...

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

Silicate Binder

Has many advantages as a bond and in mold and core production.

Development of Moroc, a new and improved silicate-based sand binder for production of molds and cores, is claimed to represent a marked departure in chemical formulations from conventional approaches to silicate-based binders.

Extensive tests have shown that Moroc, as a bond, won't separate on storage. In addition, it offers:

- Low viscosity—permitting easy mixing.
- Good bench life.
- Superior gas reaction.
- Good storage life of finished cores.
- Good collapsibility.

In mold and core production, Moroc offers many advantages. Among these are:

- Increased productivity of floor space.
- Low gas evolution.
- Elimination of baking or drying operations.
- Superior dimensional accuracy in molds and cores.
- Superior casting finishes.

The new binder (developed by Diamond Alkali and Delhi Foundry Sand Co.) simplifies control, requires a minimum initial investment for new equipment. — **Delhi Foundry Sand Co., Cincinnati 33, Ohio.** 144A

Synthetic Coated Fabric

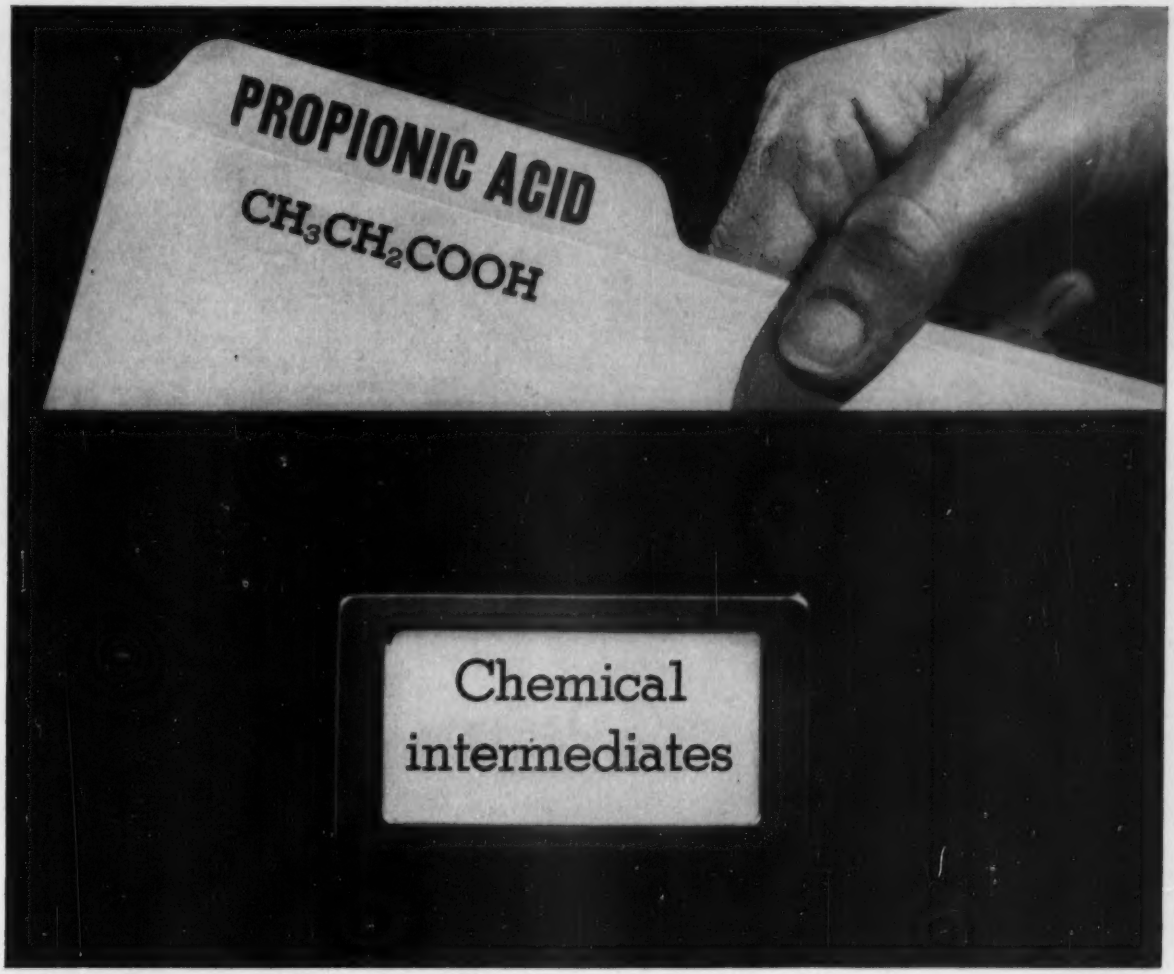
Dacron-Hypalon cloth is light weight and rugged.

Seeking to provide radar shelters with light-weight protective coverings that wouldn't interfere with efficient transmission of microwave energy, the U. S. Air Force has come up with an unusual fabric made of two well known synthetics—Dacron and Hypalon (chlorosulfonated polyethylene).

Dubbed Dacralon, the new fabric is more durable than any other cloth of its type, possessing the highest strength for a given weight of any known proofed fabric. And structures using it can realize comparable weight savings of about 50% over existing standard proofed materials (Dacralon weighs about 7½ ounces per yd.).

Dacralon also boasts versatility in that it offers excellent resistance to sunlight and ozone aging without serious degradation to its performance over extreme climatic conditions. Flexibility under arctic conditions is excellent, permitting elimination of resiliency-including plasticizers in compounding coating materials.

The fabric's exterior is coated with 3-3½ ounces per sq.



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- Intermediates for the manufacture of general-purpose herbicides
- Esters for the manufacture of flavors and floral aromas

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yd. of Hypalon; underside is coated with 1-1½ ounces. Proofed fabric has a breaking strength of 45 lb./in. And no fear of hurricanes — Dacralon-fabricated radomes can withstand wind velocities up to 120 mph.— **Air Research and Development Command, U. S. Air Force, Baltimore 3, Md.** 144B

PRODUCTS for hydraulic and related fields are first to benefit from . . .

New Diisocyanate Polyester Elastomer

Polyurethane-type synthetic claims physical and chemical properties superior to natural or other synthetic rubbers.

To meet the need for a material with better sealing properties than either natural or synthetic rubbers currently on the market, Greer Industries has come up with a new elastomer, Disogrin.

This new product, perfected in Germany, is essentially a polyurethane rubber chemically related to Bayer's Vulkollan (though Greer prefers to call it a diisocyanate polyester elastomer). And what makes it so valuable, particularly in the hydraulic field and where abrasion is a problem are its physical and chemical properties, which vary with different Disogrin compounds:

- Tensile strength—5,470 to 7,230 psi.
- Abrasion—22 to 35 (Buna-N is 65).
- Shore hardness "A"—80 to 90.
- Resilience—33 to 60%.
- Elongation—540 to 750%.

In addition to the above, Disogrin is flame retardant; operates over a wide temperature range; resists aging, high ozone concentration, oil and jet fuels, radioactivity—all contributors to rapid deterioration of gaskets, seals, O-rings and bladders made of conventional elastomers.

Two basic types of Disogrin are now being manufactured—compression-injection molded and liquid cast. The latter permits molding, at lower costs, of various shapes not possible by compression methods (i.e., injection, transfer and/or extrusion). Disogrin also allows the use of intricate cores. Rods and solid pieces may be cast and samples machined, avoiding unnecessary delays and costs in making molds until the final production stage has been reached.

Because of present limited production, Disogrin cost is comparatively high. But Greer feels that this is more than compensated for by fewer replacements and breakdowns which would ordinarily cause equipment downtime and lost man-hours. The price picture should improve with large-scale production. — **Greer Industries, Inc., Jamaica 30, N. Y.** 146A

PF_5 Source

Diazonium fluorophosphate yields catalytic fluoride resembling BF_3.

To facilitate research into properties and applications of PF_5, a Friedel-Crafts catalyst, Ozark-Mahoning is making available a new diazonium hexafluorophosphate which is stable at ordinary temperatures and decomposes smoothly at 150 C. to yield two gases—PF_5 and N_2—and a liquid aryl fluoride.

Generation of PF_5 from the salt, labeled Phosfluorogen A, is simple and is carried out in ordinary lab glass equipment. PF_5 and N_2 are passed into the system in which the pentafluoride is to be used while aryl fluoride is collected in a trap.

Importance of the new pentafluoride source is tied in with some, as yet, unpublished observations on PF_5. Like BF_3, the pentafluoride is a Friedel-Crafts catalyst, but seems much milder in its action. However, unlike BF_3, it forms stable compounds with amines, but not with ethers. Therefore it can be readily separated from ethyl ether and related oxygen derivatives.

It is this ease of separation which may prove useful in catalytic reactions where ready catalyst recovery is desired.— **Research Dept., Ozark-Mahoning Co., Tulsa, Okla.** 146B

Vinyl Stabilizing System

Three times more durable than other systems.

A combination of resin, plasticizers and a four-part stabilizer system—barium-cadmium, epoxidized soybean oil, anti-oxidant and organic additive—is responsible for the remarkable stability of Mosanto's new light-stabilizing system for vinyl.

The new system has withstood 5,600 hr. of accelerated artificial weathering before failure. And though outdoor confirmatory tests aren't entirely complete (because of excessive time factor involved), they show that this new stabilization system provides about three times the outdoor durability than has been

Puzzled about getting the Right Explosion-Proof Lighting Equipment?

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For *complete* protection when making lighting installations in hazardous locations you need more than explosion-proof or dust-tight lighting fixtures. You also need UL-listed explosion-proof switches, junctions, fixture supports, unions and seals.

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previously obtainable in vinyl plastic.

All of the system's components are commercially available at costs somewhat higher than current systems. Monsanto doesn't produce or sell the stabilizers, but has applied for a patent on the new system.—**Monsanto Chemical Co., St. Louis 4, Mo.** 146C

Plastic Film

Combines properties of polyester films with those of polyethylene films.

Minnesota Manufacturing and Mining is out for a slice of the packaging field with a new, clear plastic film which combines the strength and oil resistance of polyester films with the corrosion resistance and heat sealable properties of polyethylene films.

Though the 3M company isn't divulging its new baby's chemical composition at this writing (except to say that it's a polyester-based material), it has plenty to say about its properties:

- Chemically inert.
- Heat sealable—with a bond stronger than the film— at 275-350 F., 10-60 psi. jaw pressure with ½-2 sec. dwell.
- Non-toxic.
- Resists boiling, moisture, gas permeation.
- Resists insect penetration, radiation deterioration.
- Exhibits good puncture resistance.
- Tensile strength greater than 15 lb. per inch of width.

The film can package a wide variety of items including corrosive chemicals, most lube and food oils, oil-based products, cosmetics, drugs, etc. It can also be used for dry or wet packaging of machine parts.

Priced several times higher than cellophane and most other transparent films, 3M's product is 4½ mils thick and available in widths up to 22 in., lengths to order.—**Minnesota Mfg. and Mining Co., St. Paul 6, Minn.** 148A

Synthetic Window Panes

Protect rubber, plastics, textiles from harmful ultraviolet rays.

Plastic-reinforced glass fibers and special ingredients that filter sunlight combine to make window panes for industrial buildings which store materials ordinarily harmed by ultraviolet light.

Much like the bather's suntan lotion, the new panes permit up to 50% of visible light to pass through them, but keep ultraviolet rays out.

Production of the panes involves three basic steps—placing glass fiber sheets in a mold; adding polyester resin, color pigment and other additives; closing the mold and baking.

Though the panes have a potential market in homes, their chief use is in industrial building, replacing painted glass windows. Aside from the prime advantage of barring ultraviolet ray transmission, they have these other points in their favor:

- Unbreakable.
- Resist chemicals, smoke, smog.
- Need no painting (color is molded into them).
- Resist vibrations.
- Need never be replaced.

Initial cost of synthetic panes is greater than that of ordinary glass. But savings in replacement and maintenance costs are expected to compensate for the price difference.—**Firestone Tire & Rubber Co., Akron, Ohio.** 148B

For More Information...

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

Lithium Dispersions

Gaining importance as polymerization catalysts for synthetic rubber.

Sparked by the heightened interest in lithium dispersions as possible catalysts in the production of synthetic "natural" rubber, Lithium Corp. of America has come up with the successful production of such dispersions in a variety of organic media.

Media which have been used successfully include dodecane, diisopropyl benzene, mineral oil, petrolatum and paraffin wax. Particle sizes range from 5 to 20 microns.

At present, the company doesn't have any of these preparations for sale. But it is making available instruction sheets describing their laboratory production to all interested parties.—**Lithium Corp. of America, Minneapolis 8, Minn.** 148C

Pelletized Styrene Resin

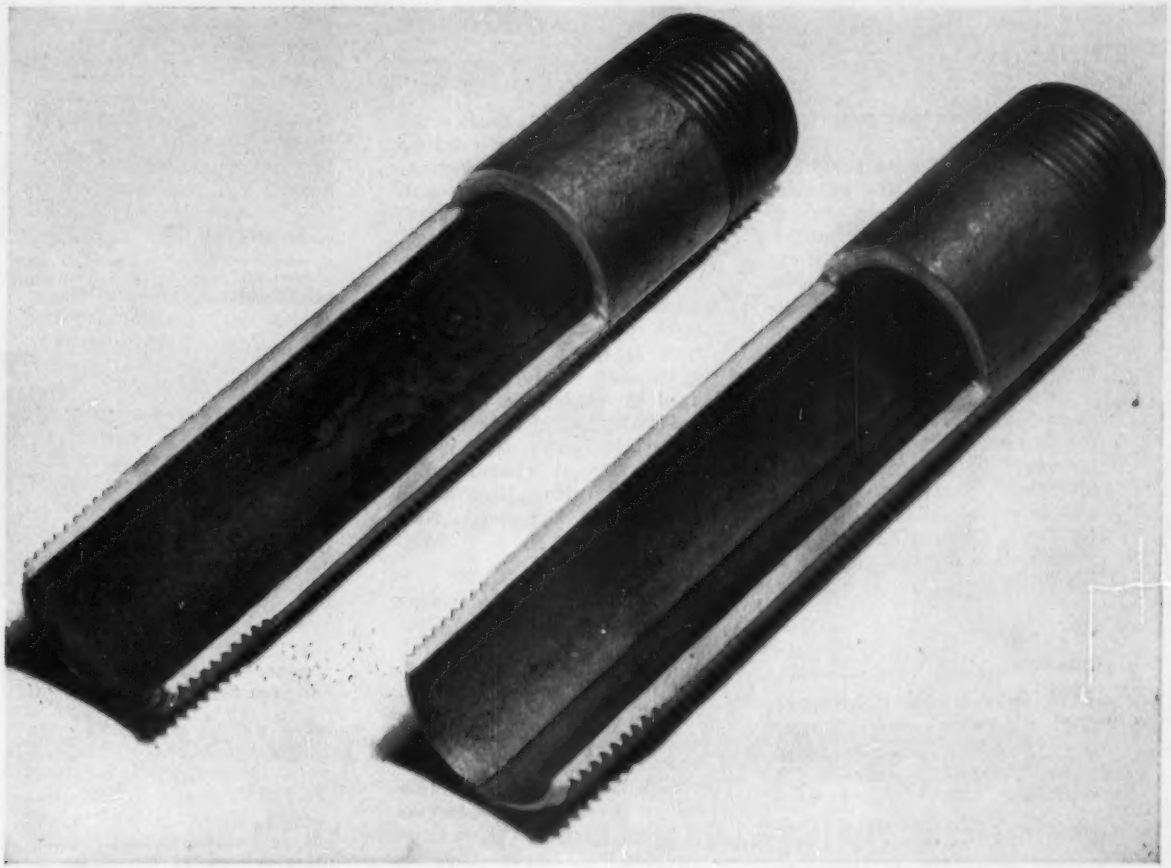
Used in injection molding, extrusion of industrial and consumer items.

Chemical inertness, good high-temperature resistance, high impact strength and good stiffness are among the chief assets of a new pelletized modified styrene resin developed for injection molding and extrusion applications.

After ten months of field testing, the new resin, Plio-Tuf P100, is now being used in a variety of industrial and consumer items.

Injection molding: liquid end valves of controlled volume pumps (*see cut*), radio cabinets, wash basins, chair arms.

Extrusion: insulation, welting



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With a low and *economical* concentration of Solvay® Sodium Nitrite you can prevent corrosion in circulating water systems, on metal parts in process and on raw sheets, tubes or bars in storage. The corrosive attack on the pipe at the left, above, is the result of plain water. The pipe on the right was subjected to identical conditions except that the water contained 500 ppm of sodium nitrite.

Solvay Sodium Nitrite works to halt or prevent corrosion by forming an invisible oxide coating on metal surfaces. It is effective with iron and steel and has been reported to suppress the degradation of aluminum, tin, monel, copper and brass. It is non-toxic in the concentrations normally used to prevent corrosion.

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and pipe, shapes having intricate cross-sections.

Extruded or molded parts can be finished using conventional equipment—and can be drilled, sawed, sanded, polished or buffed. Plio-Tuf sheets, too, can be extruded with conventional equipment, then post formed by either vacuum draw molding, drape molding, ring and plug forming, blow molding or line bending.

Pellets are uniform in size, permitting accurate metered feeding and promoting even distribution of heat through the materials. They're available in a wide variety of colors.—**Plastic Dept., Chemical Div., Goodyear Tire & Rubber Co., Akron 16, Ohio.** 148D

BRIEFS

Pure flake trimethylolpropane, at a new low price—43¢/lb. (carload)—makes for economic use of this aldol in production of polyurethanes, alkyd resins, synthetic drying oils, plasticizers, surfactants and polyesters. In alkyd-base baking enamels, trimethylolpropane contributes to better adhesion, color, color retention and hardness. It also makes for greater mixing ease in compounding polyesters and prepolymers with diisocyanates.—**Celanese Corp. of America, New York 16, N. Y.** 150A

Microcrystalline synthetic mineral waxes can be blended with high-pressure polyethylene to increase rigidity. Products of high-pressure synthesis of CO and H_2, FT waxes are chemically neutral, have the same melting point as high-pressure poly and a high softening point. They're compatible in all proportions with poly and don't separate after blend has been aged. Waxes improve poly's transmission barriers for water and alcohol vapor, gas and odor.—**Dura Commodities Corp., New York, N. Y.** 150B

Anthraquinone vat dye, latest in manufacturer's expanding line, is National Carbanthrene Direct Black 3G Double Paste. Non-drying paste produces greenish-black shades on cotton and rayon, is unaffected by presence of metals in the dyebath, is suitable for use in all types of dyeing equipment. It also offers maximum fastness to light in heavy shades, excellent fastness to most wet processing. Paste can be used in production of resin-finished apparel fabrics and materials that are subsequently to be rubberized.—**National Aniline Div., Allied Chemical & Dye Corp., New York, N. Y.** 150C

Sprayable plastisol, Unichrome Super 5300, makes possible gun application of the full solids content of vinyl plastisol without a diluent. As a result, a pore-free, 50-60 mil coat (triple the thickness previously possible) can be successfully applied in one layer which gives sheet protection to tanks, ducts and other large equipment. Super 5300 is based on vinyl resins and is resistant to corrosive action of strong acids, concentrated caustic and salt solutions, etc. It forms a tough, flexible film which absorbs impact, withstands abrasion, has desirable acoustical and electrical insulating properties.—**Metal & Thermit Corp., Rahway, N. J.** 150D

Rare earth oxides and salts—in purities from 98-99.9%—are being offered for immediate, quantity delivery. Compounds may be ordered as oxides, acetates, chlorides, nitrates and sulfates.—**Research Chemicals, Inc., Burbank, Calif.** 150E

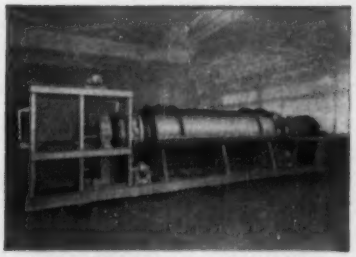
Two sulfonic acids derived from palmitic and stearic acids are sulfo-stearic and alpha sulfo-palmitic acids. Both contain a strongly ionized sulfonic acid group and one carboxyl group, making possible a variety of normal and mixed derivatives which have promise in a number of fields — e.g., detergents, greases, ore flotation, butadiene-styrene polymerization, fuel or lube oils, chemical intermediates. Both acids are available in pilot-plant quantities.—**Armour and Co., Chicago 9, Ill.** 150F

Anabolic drug, Nilevar, is expected to contribute to the rebuilding of human tissue in many diseases and surgical conditions. Clinical work shows that the new drug assists both in patient recovery following major surgery and in preparation of patients for surgery when they aren't physically fit to undergo operations. It also improves the nutritional state of patients with severe illnesses, aids in arresting wasting of patients with lingering illnesses.—**G. D. Searle & Co., Chicago 80, Ill.** 150G

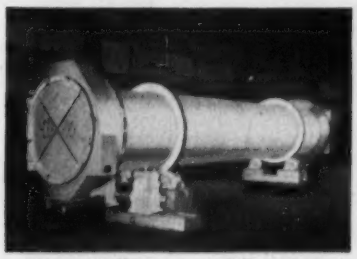
Lithium metal, in one-pound ingots, is now available from Foote Mineral's Exton, Pa., plant. Metal, packed under oil in sealed cans, typically analyzes 99.8% Li. Company expects to offer development size quantities of a number of lithium derivatives soon.—**Foote Mineral Co., Philadelphia 44, Pa.** 150H

Resin softener, Wica Softener Apt, is a 50% active amphoteric compound recommended for use in resin baths and for application to fibers normally difficult to soften. It resists yellowing at high temperatures; is compatible with a wide range of finishing materials; resists laundering, dry cleaning and chlorine dioxide treatment.—**Wica Chemicals, Inc., Charlotte, N. C.** 150I

Vinyl toluene and vegetable oil-based paints, tradenamed Keltrol, have excellent hardness, high gloss and dry rapidly. Keltrol 1001 is 60% solids in mineral spirits; Keltrol 1013 is 60% solids in xylol. Applications: air drying or baking industrial enamels; hammer, floor, polychromatic finishes; special primers; caulking compounds. — **Spencer Kellogg & Sons, Inc., Buffalo, N. Y.** 150J



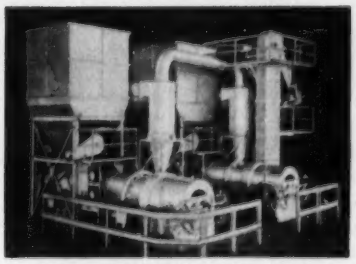
Indirect Heat Rotary Combination Calciner and Cooler for Processing Catalyst in Hydrogen Atmosphere.



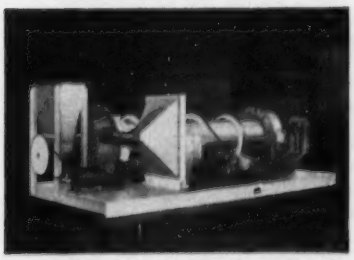
Special 60" Dia. by 32'0" Stainless Steel Dryer for Processing Plastics without Color Contamination.

FROM Anti-Biotics TO Zirconium

Call BARTLETT-SNOW'S experienced specialists on every drying and heat processing problem



Two Completely Self-Contained Drying Systems Operated Singly or Together—Showing Materials Handling and Dust Collection Facilities.



Specially Designed Drying Unit that Removes Organic Solvent from Newly Developed Antibiotic.

Whether the material you wish to process is light or heavy, fine or coarse, abrasive or corrosive, we can design and build the exact size and type of equipment best suited for your particular product and capacity requirements.

Our wide experience and proven mathematical approach enables us to determine accurately the heat sensitivity, permissible temperatures, entrainment losses, desirable velocities, balling, sticking, cooling and all other chemical and physical aspects. Material can even be test run in our fully equipped heat processing laboratory, and samples of the finished product produced before the production equipment is designed or built. Let us work with you on your next job. We can handle any project including the complete materials handling and dust collection facilities. This assures fixed unit responsibility; the smooth, synchronized operation of all parts of the installation and utmost economy and satisfaction.

DESIGNERS ENGINEERS FABRICATORS ERECTORS

BARTLETT-SNOW CLEVELAND 5, OHIO

DRYERS • COOLERS • CALCINERS • KILNS — *Complete Facilities Including Materials Handling*

This research engineer is using an L&N Recording Spectrometer to determine hydrogen-deuterium ratios. These will be plotted on the Speedomax recorder at top left.

When you automate your Lab, call in L&N

Measuring the pH of a new toothpaste? Analyzing the output of a gas generator? Determining metal traces in used engine oil? If you use electro-chemical methods of analysis . . . or could use them . . . you'll like the fast, accurate results that L&N's analytical equipment can give you. These instruments, a specialty with L&N, are specifically designed for use in the following fields.

Spectroscopy. L&N offers two equipments. Our high-resolution Recording Spectrometer provides direct measurement of spectral line intensities in the visible and ultra-violet regions. For recording line densities from spectrographic plates, the Knorr-Albers Microphotometer is widely used.

Polarography. Either automatic or manual instruments are available, depending upon your needs. Our polarographic recorder, the Electro-Chemograph®, is distinguished for its high resolution and high speed. For manual polarography, simply take standard laboratory potentiometer and galvanometer, and use them with L&N's Calibrating Unit.

pH. Our complete line of pH measuring equipment includes both laboratory and industrial instruments. The stabilized, line-operated indicator, and portable pH indicators, meet all laboratory needs. Continuous records of research and pilot plant operations are made with Speedomax® pH Recorders and Controllers.

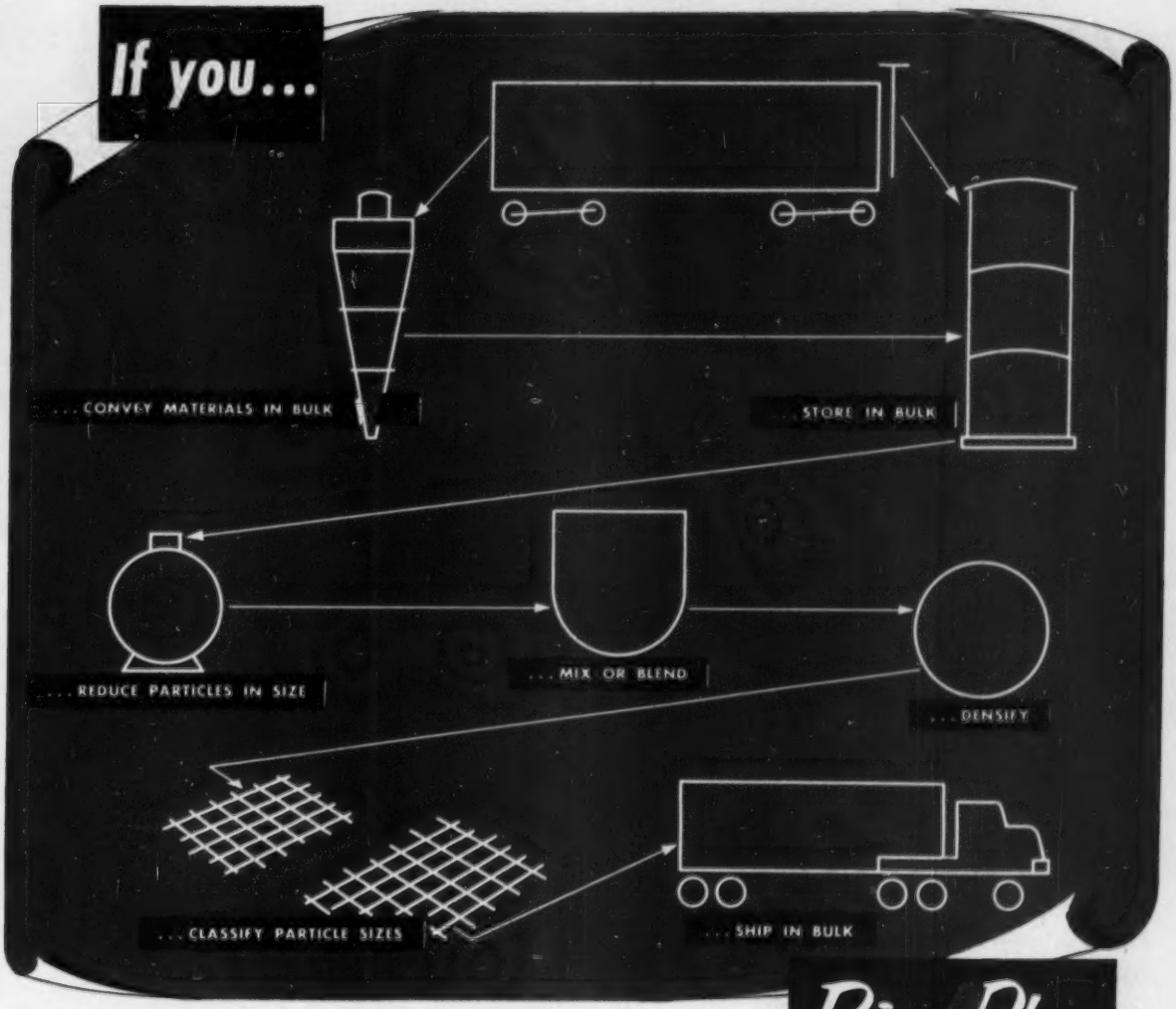
Electrolytic Conductivity. L&N offers instruments for any desired electrolytic conductivity measurements. Precise laboratory measurements (overall limit of error 0.01%) are possible with the Jones Conductivity Bridge. If limits of $\pm 0.3\%$ to $\pm 1\%$ are satisfactory, you can choose from three types of portable indicators. Continuous records of laboratory experiments are plotted with Speedomax Conductivity Recorders.

Gas Analysis. Three types of gas analysis equipment are available. CO_2, SO_2, and other gases are determined with the Thermal Conductivity Analyzer. Oxygen content is accurately recorded with the Unitized O_2 Analyzer, while gas mixtures in compounds are measured with the Infrared Gas Analyzer.

An L&N application engineer will be glad to send or bring information if you give him such data as you may feel free to discuss. Address us at our nearest office, or at 4916 Stenton Avenue, Philadelphia 44, Pa.

LEEDS N NORTHRUP

instruments automatic controls • furnaces



SPROUT-WALDRON offers you a Big Plus

Many of America's greatest processing companies (names on request) can testify that...

Sprout-Waldron installations achieve a degree of specific fitness that is unusual in industry.

This success is due to a unique application of engineering know-how and imagination to the solving of difficult processing problems... PLUS... wide selections of virtually all types of processing equipment ...PLUS...an ability to "adaptioneer" machines to meet individual needs...PLUS... manufacturing facilities that include fabricating, machining, custom founding, woodworking, and laboratory testing.

Put these **BIG PLUS** factors to work for you. Let Sprout-Waldron analyze your processing problems and recommend solutions. You'll find new ways to cut costs and save money.

Write for free Bulletin 95—an informative treatise on equipment and systems for processing dry and semi-dry materials.

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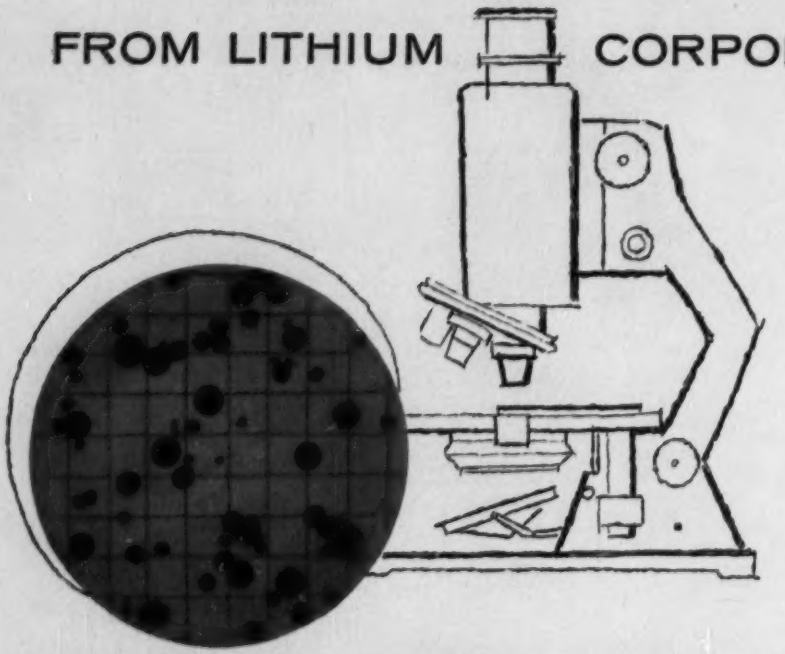
PR/413

ANNOUNCING A NEW

RESEARCH TOOL

FROM LITHIUM CORPORATION...



LITHIUM DISPERSIONS

Our successful development of dispersions of Lithium Metal offers industry still another research technique once considered impractical. Readily prepared, lithium dispersions prove more stable to air and moisture than the metal itself due to the coating of the dispersing medium.

In case you have a problem requiring the use of highly reactive Lithium Metal, Lithium Corporation's PR&D department is making available product data sheets describing the methods for laboratory preparation of these lithium metal dispersions in such dispersing mediums as mineral oil, petrolatum and wax. A request attached to your letterhead will bring you information on this new tool in lithium research.

... trends ahead in industrial applications for lithium

LITHIUM CORPORATION OF AMERICA, INC.
2505 RAND TOWER
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MINES: Keystone, Custer, Hill City, South Dakota • Bessemer City, North Carolina • Cat Lake, Manitoba • Amos Area, Quebec • BRANCH SALES OFFICES: New York Pittsburgh • Chicago • CHEMICAL PLANTS: St. Louis Park, Minnesota • Bessemer City, North Carolina • RESEARCH LABORATORY: St. Louis Park, Minnesota

TWO GREAT NAMES

Teamed For Quality...Service...Progress

Two steelmakers, each known for its achievements in its own particular field of producing forged and annular rolled products are now combined to supply requirements of the largest and smallest. Two groups of production and research engineers are joined to better serve American industry. The new company is a totally owned subsidiary of Heppenstall and will operate independently. Each company will continue to offer American industry the custom made products for which it is famous.

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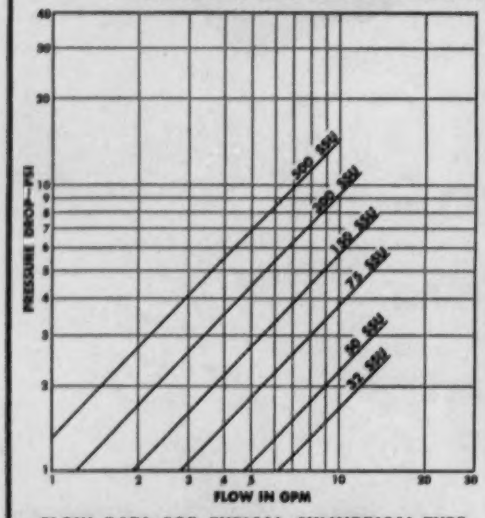
NICETOWN
PHILADELPHIA 40, PA.

A SUBSIDIARY OF HEPPENSTALL COMPANY

DESIGN AND APPLICATION NOTES ON

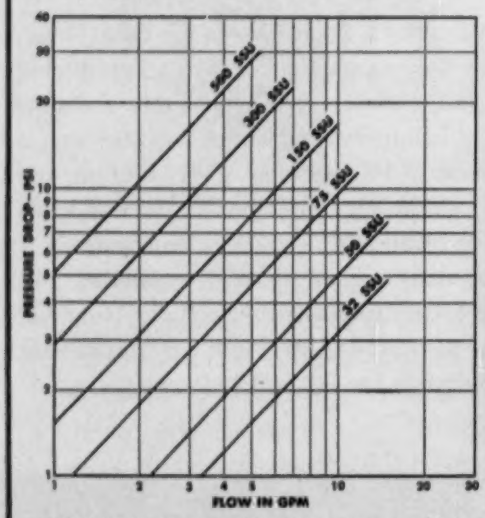
Cuno's new Poro-Klean Filter

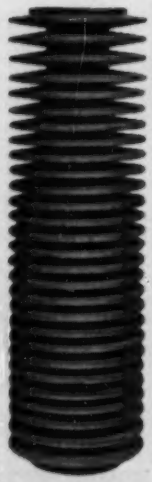
TYPICAL PORO-KLEAN FLOW DATA



CYLINDRICAL TYPE

FLOW DATA FOR TYPICAL CYLINDRICAL-TYPE, coarse-grade, PORO-KLEAN filter element, fluid viscosity as parameter. Filtration to 15 microns.





CELL TYPE

FLOW DATA FOR TYPICAL CELL-TYPE, medium-grade, PORO-KLEAN filter element, fluid viscosity as parameter. Filtration to 5 microns.

Precision 3-to-30 micron filter for high temperature and high pressure

PORO-KLEAN, Cuno's new porous stainless steel filter material, now offers the chemical, petrochemical, nuclear, and process industries true micronic filtration for temperatures to 900°F and differential pressures to 2000 psi.

Standard in 316 stainless steel, with low carbon content (0.03 to 0.05% max.), PORO-KLEAN is an ideal filter material for use in applications requiring corrosion resistance, high strength (ultimate tensile strength: 25,000 psi), high resistance to hydraulic shock, or positive freedom from fluid contamination.

Typical PORO-KLEAN applications, already in use in the chemical and process industries, are listed below. Approximate flow-rate curves for typical cell and cylindrical standard elements are shown at left (for exact data, see your Cuno representative).

TYPICAL PORO-KLEAN APPLICATIONS

TO REMOVE:

- Resin and airborne contamination from demineralized water
- Fixed-bed catalyst fines from petroleum products
- Over-cooked gels from polymers
- Radioactive contamination from light and heavy water
- Fine precoat particles downstream from primary filters
- Contamination and/or catalysts from high-temperature and high-pressure refinery gases
- Metal oxides from molten sodium, sodium-potassium, and bismuth
- Iron oxides from fuels
- Rust from steam
- Foreign matter from pharmaceuticals

TO RECOVER:

- Catalysts from gases and liquids

TO DISPERSE:

- Gases into liquids and other gases

If you have problems like these, let Cuno engineers help you apply PORO-KLEAN to their solution. See your Cuno representative, or write Cuno Engineering Corporation, 31-8 South Vine Street, Meriden, Conn. 5.20

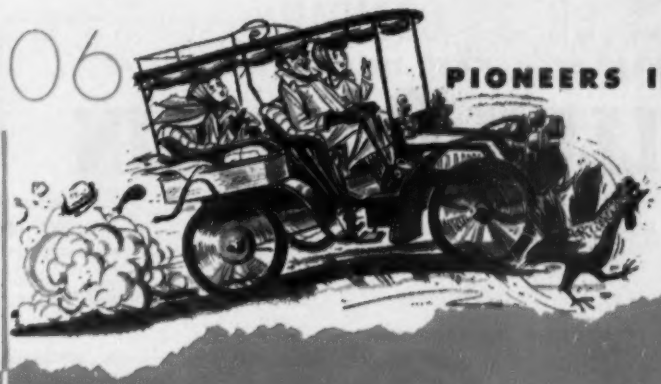
CUNO

ENGINEERED FILTRATION

Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (edge type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound) • PORO-KLEAN (porous stainless steel)

1906



PIONEERS IN ENGINEERING PROGRESS

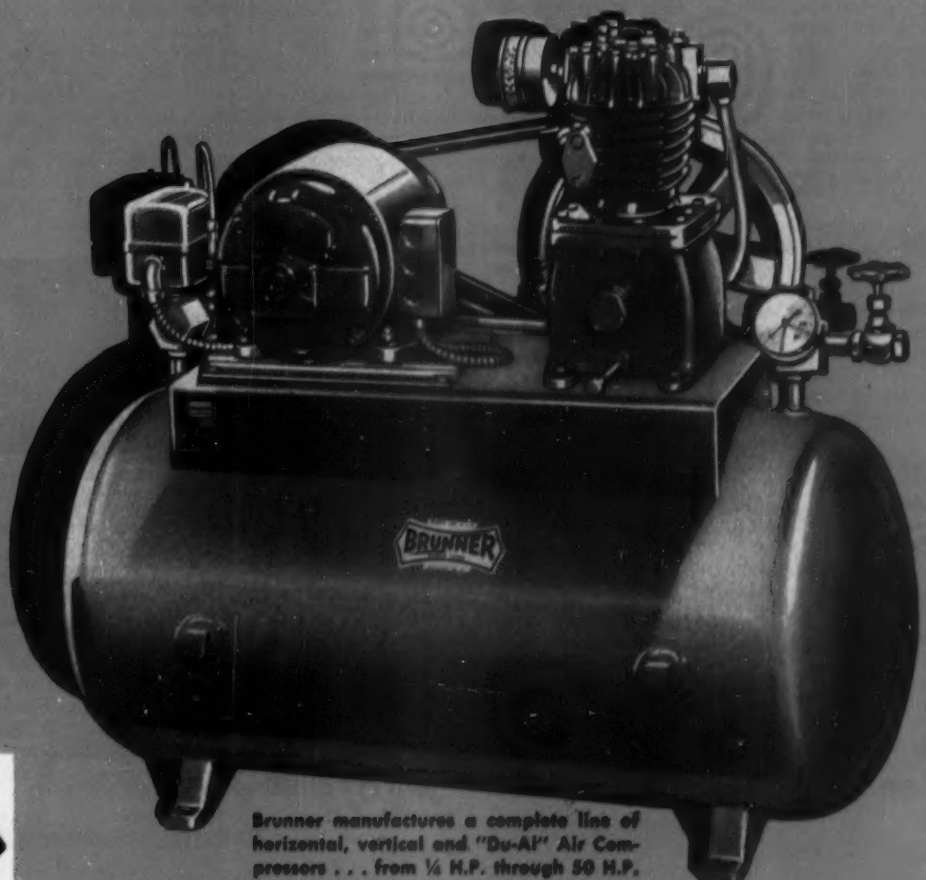
Introduced in 1906 . . . the first Brunner air compressor, like the "horseless carriage", was an engineering achievement of the times.

TODAY . . . Tested by the past . . .

choose BRUNNER for the future!

There's a Brunner Air Compressor for every job that requires compressed air.

BRUNNER MANUFACTURING COMPANY, UTICA, N. Y.
THE BRUNNER CO., GAINESVILLE, GA.
IN CANADA: BRUNNER CORP. (CANADA) LTD., TORONTO, ONTARIO



Brunner manufactures a complete line of horizontal, vertical and "Du-Al" Air Compressors . . . from ¼ H.P. through 50 H.P. . . . to fit any space, for every need.

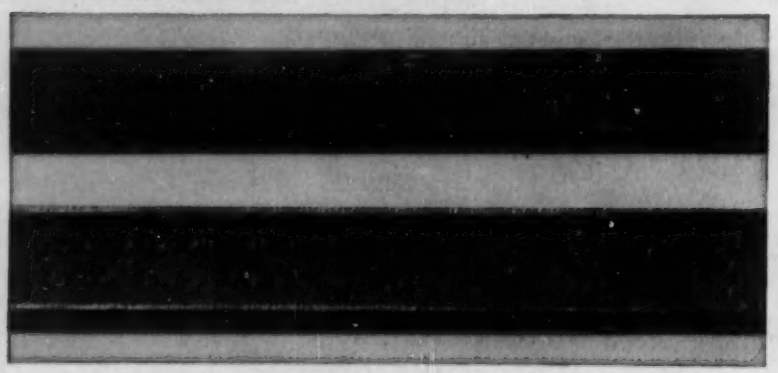
50th Anniversary BRUNNER

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

Bridgeport Brass Co. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



Sections of low-carbon steel condenser tube showing extensive effects of rust and corrosion on the water side in comparison to the unaffected surface of the ammonia side.

Duplex Tubes In Ammonia Condensers Can Cut Power Costs Up To 25%

The use of ammonia and other refrigerants in refrigeration systems has increased tremendously in recent years. Many problems—old and new—involving the handling of corrosive gases and liquids continue to crop up in domestic, industrial, processing, chemical and refining applications of refrigeration and air conditioning. It is important that we learn how to handle these corrosive gases and liquids.

In general, condenser tubes in refrigeration systems are subjected to dual corrosion; that is, one type of corrosive action inside the tube, an entirely different type on the exterior side. For this reason Bridgeport Duplex Tubes—with one metal inside and a different metal outside—are finding ever-wider application in the solution of these complex corrosion problems.

Ammonia Refrigeration

Although dry ammonia gas is not corrosive to many metals and alloys, it is not always used in the completely dry condition. When ammonia contains dissolved salts, water, air or other common contaminants, it severely attacks copper and copper-base alloys.

Steel, on the other hand, is very resistant to ammonia corrosion, and is widely used in equipment handling ammonia (both anhydrous and moist). However, low-carbon steel tubes have a major shortcoming that prevents their being the universal answer to ammonia refrigeration corrosion problems, namely; water corrosion.

Corrosion from the water or brine side has always been a problem with low-carbon steel tubes. While steel tubes are satisfactory in withstanding corrosion from the *ammonia* side, the water side rusts quickly... builds up a heat-insulating layer which must be removed from time to time at considerable cost.

This problem is now being overcome through the installation of Duplex Tubes composed of low-carbon steel to the ammonia side, and copper or copper-base alloys, on the water side. For circulating fresh water—Admiralty #30, Red Brass #85, or Copper are recommended. Where sea water is used for cooling, Aluminum Brass #54, Duronze IV #53 (Arsenical Aluminum Bronze) and Admiralty #30 are preferred because of their greater resistance to dezincification corrosion, and general corrosion by sea water. When velocity of sea water is comparatively high, greater resistance to impingement corrosion is given by Duronze IV #53 and Aluminum Brass #54.

With Freon and methyl chloride refrigerants in a dry condition, copper and copper-base alloys have proved very satisfactory for corrosion resistance and long tube life. Arsenical Admiralty #30 or Aluminum Brass #54 are recommended for installations using sea water as the coolant. Copper, Red Brass, Admiralty, etc. are popular for fresh-water installations.

How Bridgeport Duplex Tubes Can Save You Money

Improved Heat Transfer. Mechanical bonding between the two components of Duplex Tubes is so tight that very satisfactory heat-transfer characteristics result. In addition, slime, algae and marine growths have less tendency to foul copper-base alloys than steel. Using copper or copper alloys on the water side therefore improves heat transfer because single-wall steel tubes pile up a thick insulating coat of rust which lowers heat-transfer value.

Reduced Maintenance, Shutdown Time and Labor. An ice company that replaced its steel tubes with Duplex (steel/Admiralty) reported two years later that four semi-annual cleanings were avoided... operating pressures are running 15 to 2 pounds lower... and that their Duplex Tubes have already paid for themselves.

Cut Power Costs! Replacement of corroded steel tubes in ammonia condensers has reduced power costs in some cases as much as 25%.

Greater Corrosion Resistance. Corrosion from water is often most severe at the inlet end of steel tubes, where turbulence is highest. Duplex Tubes will give greater corrosion resistance toward scale-forming waters which have been treated. And often in untreated raw waters—which would corrode low-carbon and stainless steels—Duplex Tubes can be used successfully.

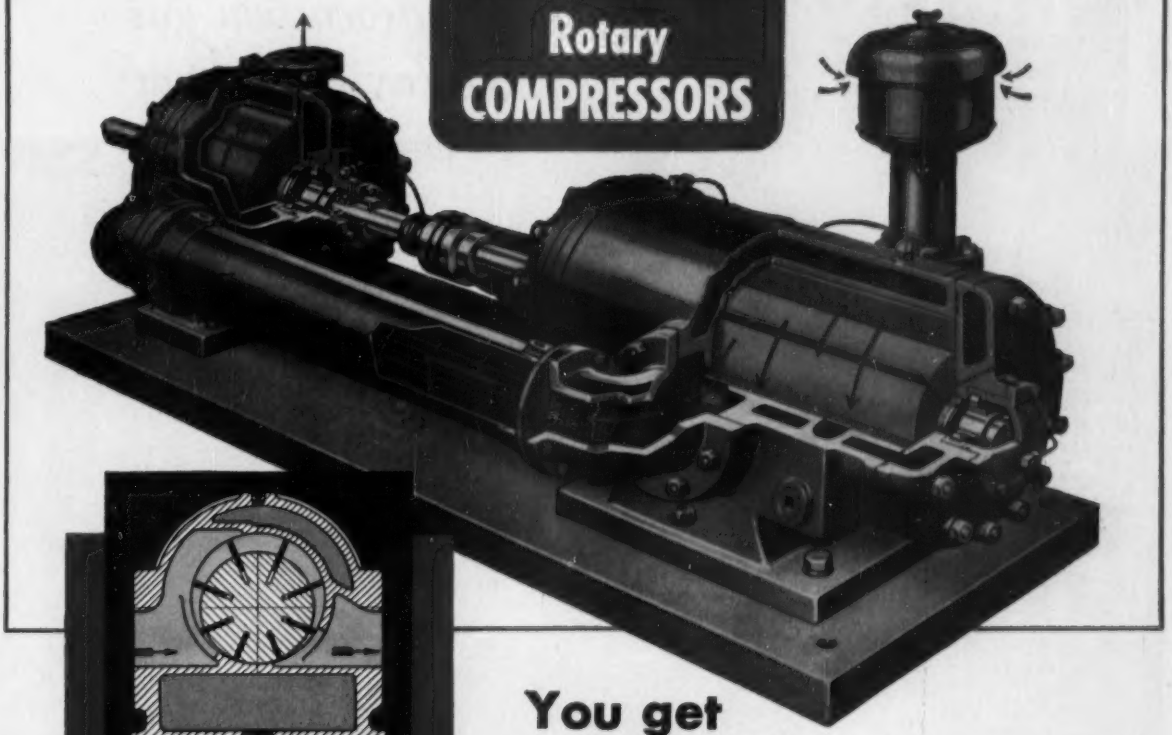
Ammonia condensers equipped with Steel/Copper Duplex Tubes—Courtesy York Corporation.

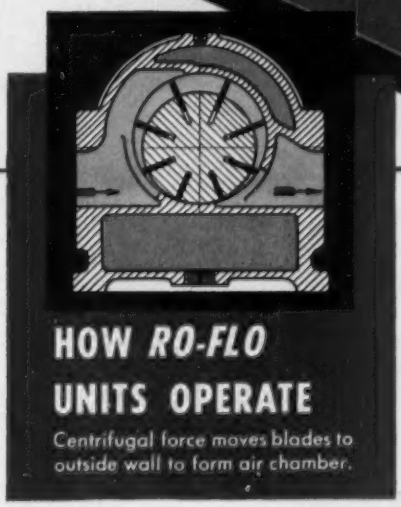
More Than 100 Combinations

Bridgeport produces a wide variety of alloys, from which more than 100 Duplex Tube combinations can be manufactured. Specialists in our Corrosion Laboratory will gladly assist you in determining the condenser tube alloy that will give the best service in your specific application. Please write or phone your nearest Bridgeport Sales Office today for this expert assistance, and for delivery of Bridgeport high-quality copper alloys. (1198)

ALLIS-CHALMERS

Rotary COMPRESSORS





HOW *RO-FLO* UNITS OPERATE

Centrifugal force moves blades to outside wall to form air chamber.

You get MORE ADVANTAGES

with *RO-FLO* units for shop air, drilling, gas handling

TYPE and SIZE for EVERY NEED

Both single and two-stage *Ro-Flo* compressors are available. Single-stage units for pressures to 50 pounds gauge, and volumes from 42 to 3245 cfm.

Two-stage units in twelve sizes for 250 to 1800 cfm at pressures from 60 to 125 pounds gauge.

Single and two-stage *Ro-Flo* vacuum pumps for vacuums to 0.3 inch mercury absolute, from 22 to 5950 cfm.

Call your nearest A-C office or write for bulletins 16B8244 (two stage) and 16B8126 (single stage). Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

1. **CONSTANT EFFICIENCY**— During operation the sliding vanes of the rotor press against the cylinder wall to form air cells. Even if these vanes wear, the rotating force holds them in contact with the cylinder wall so that efficiency and air flow never change.
2. **LOW-COST FOUNDATIONS**— Smooth rotation cuts vibration. This eliminates need for heavy foundations used with reciprocating-type units. Small units can be bolted directly to the floor. Large units need only a simple slab.
3. **COMPACTNESS**— No extra weight or extra size is needed to dampen vibration. Every inch is devoted to air or gas handling.
4. **LOW MAINTENANCE**— There is no wear and tear from shock and vibration . . . no pistons and valves.

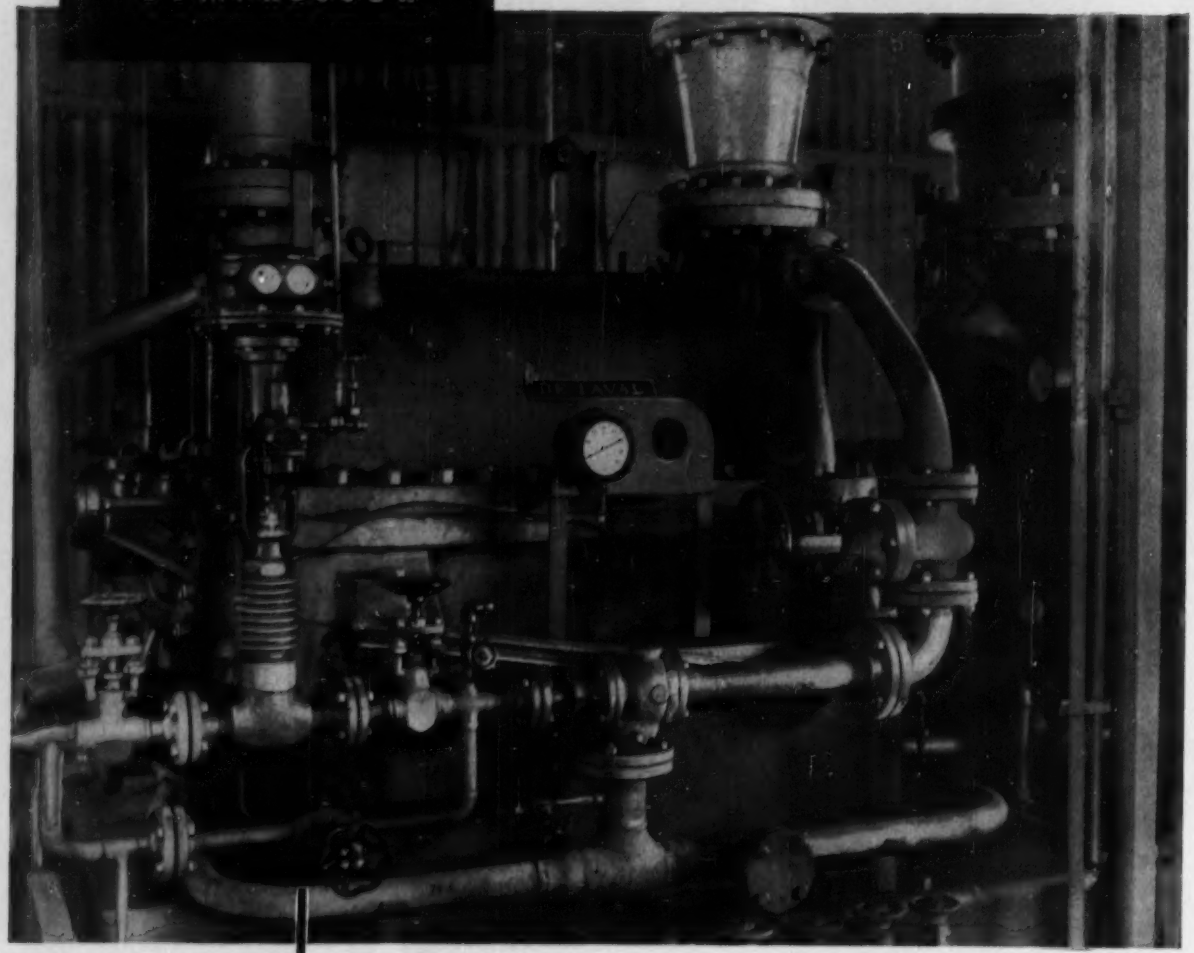
Ro-Flo is an Allis-Chalmers trademark.

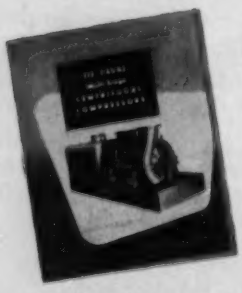
A-5028

ALLIS-CHALMERS

DE LAVAL CENTRIFUGAL COMPRESSOR

handles hydrocarbon gas in Sunray Oil refinery





Send for new Bulletin 0504

This De Laval 7-stage centrifugal gas compressor, installed at the Duncan, Oklahoma refinery of the Sunray Oil Company, handles a heavy hydrocarbon gas in a delayed coking process. The gas has a molecular weight of 31.5.

The De Laval centrifugal compressor is rated at 2840 inlet cfm; discharge pressure is 240 psia. The power required is 1350 bhp with compressor operating at 9900 rpm.

Sunray Oil is another refinery which has selected De Laval compressors for heavy-duty continuous service. Rugged, horizontally split casings, individually designed impellers, perfectly balanced rotors and externally mounted, cylindrically seated bearings are design features that assure optimum performance and long service.

DE LAVAL *Centrifugal Blowers*

DE LAVAL STEAM TURBINE COMPANY
803 Nottingham Way, Trenton 2, New Jersey

DL 837

now, Crucible low nickel stainless steels that meet many of your needs . . .

Here are two *new* Crucible grades, Rezistal type 201 and 202 that are similar in quality and properties to types 301 and 302 . . . but with desirable features all their own.

In the annealed condition, for example, Rezistal 201 and 202 have about 10% higher strength than 301 and 302, yet maintain almost identical ductility. This means that these grades can be fabricated with ease equal to their counterparts. In addition, their mill finishes and corrosion resistance to a wide variation of media compare most favorably with 301 and 302.

To sum up: Rezistal 201 and 202 have practically all the desirable properties of 301 and 302, *plus* some of their own. And they're available *promptly* in all forms. Write now for data sheets fully covering the properties of these new stainless grades. *Crucible Steel Company of America, Dept. ACE, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

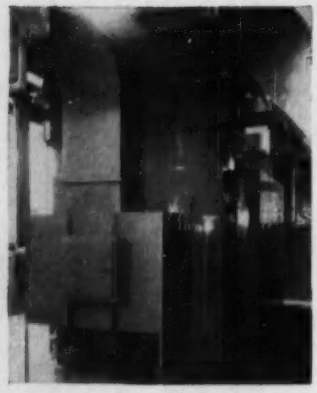
CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

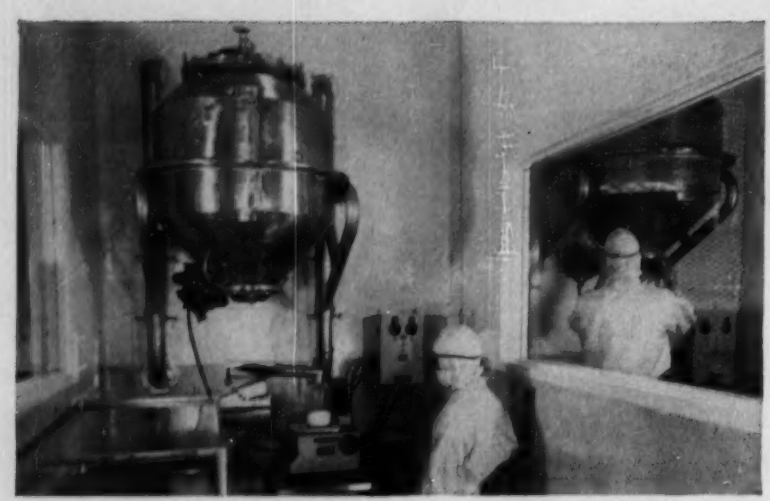
Canadian Distributor—Railway & Power Engineering Corp., Ltd.

Pfizer adds this invisible ingredient...

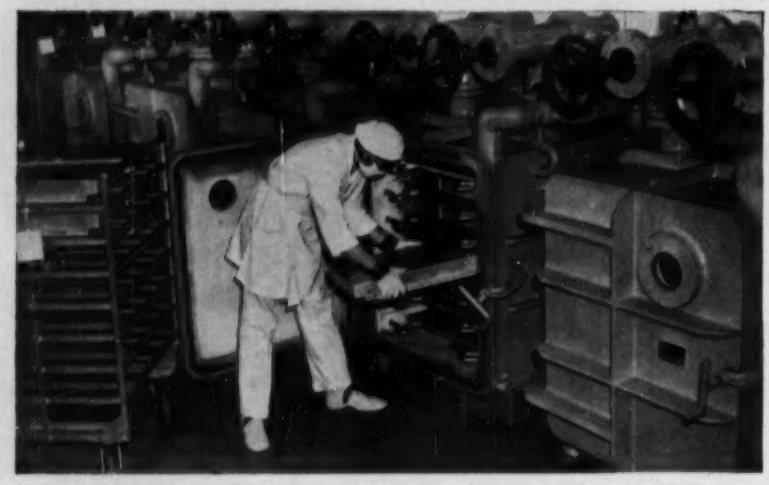
DRYness by LECTRODRYER*



Air-conditioning type Lectrodryer



Sterile rooms at various plants of Chas. Pfizer & Co., Inc. are maintained at a constant low humidity by Lectrodryers.



• Formulation, processing and packaging of many Pfizer pharmaceutical products are carried on in DRY atmospheres. 10% relative humidity is quite common in their operations. Thus they safeguard moisture-sensitive materials and methods by eliminating this variable and holding moisture at a constant, low figure.

Lectrodryers are placed at strategic locations throughout Pfizer plants, near the areas and equipment they serve. Sterile conditions are not disturbed by their moisture-removing activity.

Are you troubled by moisture in the air surrounding or entering into your processes, in gases or organic liquids? There's a Lectrodryer to remove every trace of moisture—efficiently, dependably and costing little to maintain. Our engineers will advise you on moisture-removal methods and equipment.

The booklet, *Because Moisture Isn't Pink*, describes Lectrodryer installations in many industries. For a copy, write Pittsburgh Lectrodryer Company, 303 32nd Street, Pittsburgh 30, Pennsylvania (a McGraw Electric Company Division).

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
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Here are typical examples of COWLES efficiency compared to ordinary equipment—

Fungicide preparation	Quick dispersion of reactants—finer particle size.
Paint premixes	Ultimate dispersion of pigments up to 10 times as fast.
Sodium dispersion	Smaller particle size. Cleaning problems eliminated.
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Ink premixes	Higher quality in half the time of paste mixer.
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Plastisols and Organisols ..	Satisfactory products in a fraction of the time.

Let us prove it in your plant... AT OUR RISK!

You can expect the demonstration to prove that Cowles Dissolvers are the most compact, efficient machines on the market. They will handle a wide variety of materials with viscosities ranging up to and in excess of 50,000 centipoises. Direct peripheral action of new, patented impellers at 3600 to 6000 F.P.M. imparts high velocity to material, creates zones of intense turbulence and shear, breaks down agglomerates to ultimate dry particle size and surrounds each particle with a film of liquid. Operation may be by batch, semi-continuous or continuous.

Typical advantages include faster production, improved quality, greater yields, lower power consumption. All add up to better products at less cost—more profits for you.

If *milling* is required—for grinding or similar processing of organic, inorganic or synthetic materials, a new, improved Morehouse Mill will do the job up to four times as fast. Stainless steel construction prevents contamination—positive adjustment assures accurate end-product control and consistency.

MOREHOUSE MILLS, to produce finest quality products at rates nothing less than spectacular. A trial will convince you that you too can

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for processors of liquid-liquid, gas-liquid and solid-liquid products, including... Chemicals, Paints & Inks, Plastics, Pharmaceuticals, Foods, Beverages

MANY MODELS TO CHOOSE FROM
—special engineering adaptations if necessary

Wide variety of dissolver models and capacities. Tank types, mobile and tip-up units, special adaptations.

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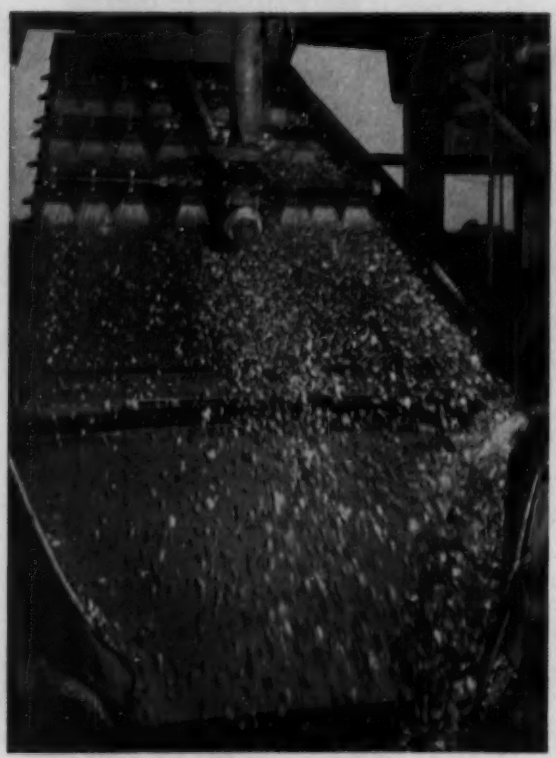
Typical stainless steel unit, available in variety of models and sizes.

Laboratory mill for testing and small batches. Results identical to larger units.

Choose a LINK-BELT Vibrating Screen for your screening job

Sizing, Scalping, Dewatering, Rinsing . . . at LOW COST

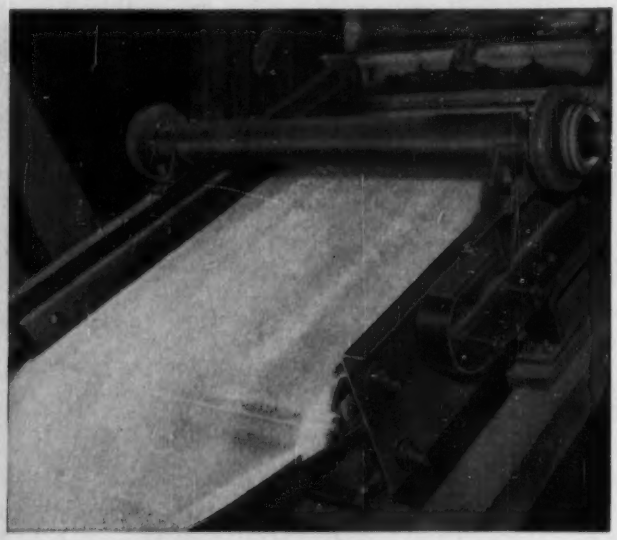


Link-Belt "CA" Vibrating Screen and non-clogging spray nozzles are combined for efficient washing and sizing.

CA

For high-capacity screening of a broad range of materials—Link-Belt "CA" Vibrating Screens are your answer. Concentric Action of vibrator mechanism imparts positive, uniform, circular motion to every square inch of the screening surface. Centrifugally-actuated, unbalanced weights reduce vibration of accelerating and decelerating—are easily adjusted to the amplitude of highest screening efficiency. What's more, lively vibrating action achieves bed stratification *fast*—assures accurate sizing, thorough rinsing, rapid dewatering. Made in a complete range of sizes to suit all plant capacity requirements—single, double or triple decked.

Call your nearest Link-Belt office or write for new Book 2554.



Here fine silica sand is effectively sized by a double-deck Link-Belt "UP" Unbalanced Pulley type vibrating screen.

UP

For economical separation of light to medium weight materials—choose Link-Belt "UP" Vibrating Screens. Positive, high-frequency action over entire area of cloth provides maximum sizing opportunity for every particle. Even on the smallest cloth sizes, blinding is virtually eliminated. And you'll like the lower power and maintenance costs resulting from two-bearing simplicity. "UP" screens are available in open, semi-enclosed, or totally-enclosed types, single or multiple decks in a wide range of sizes.

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LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarsboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13,817

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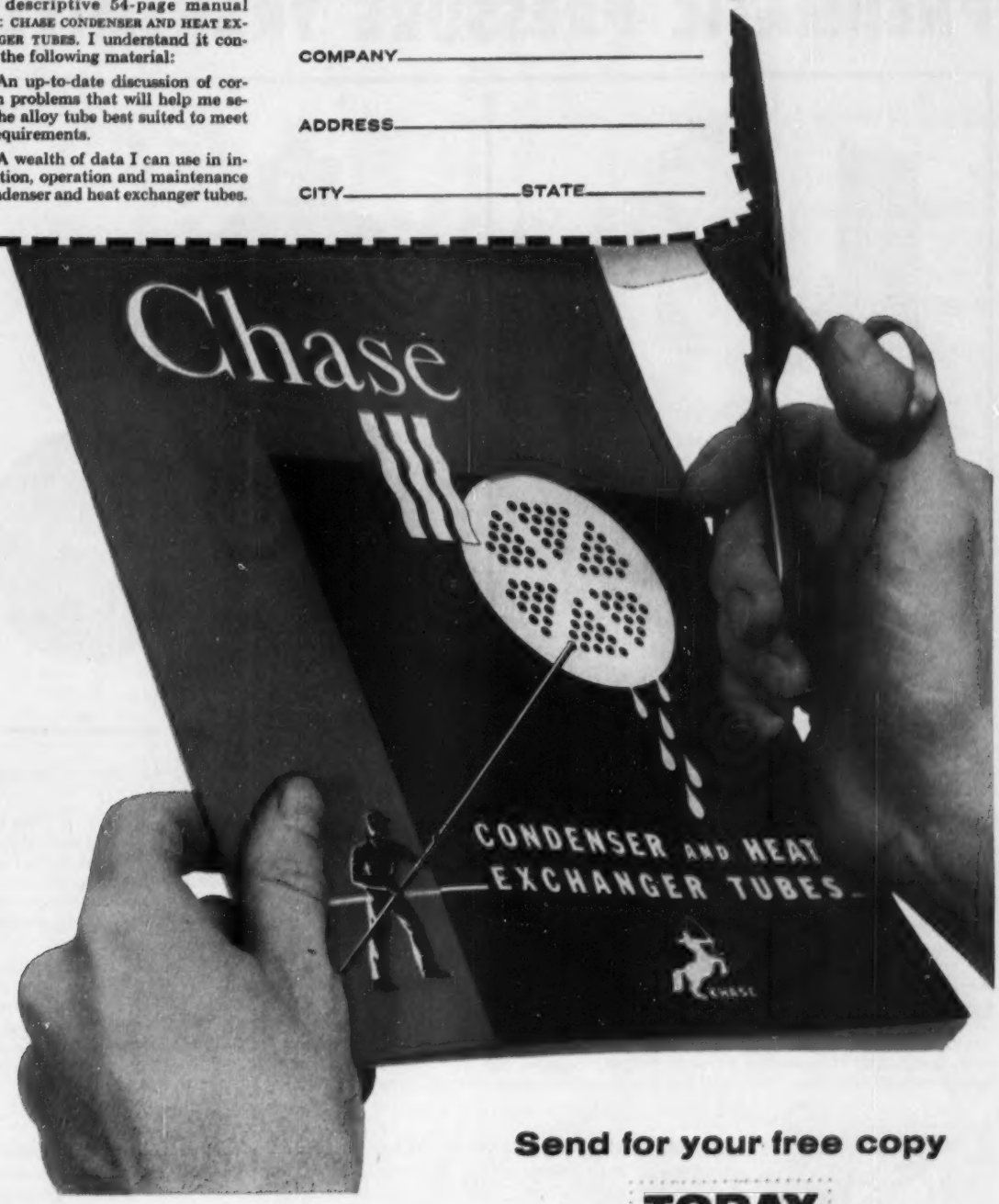

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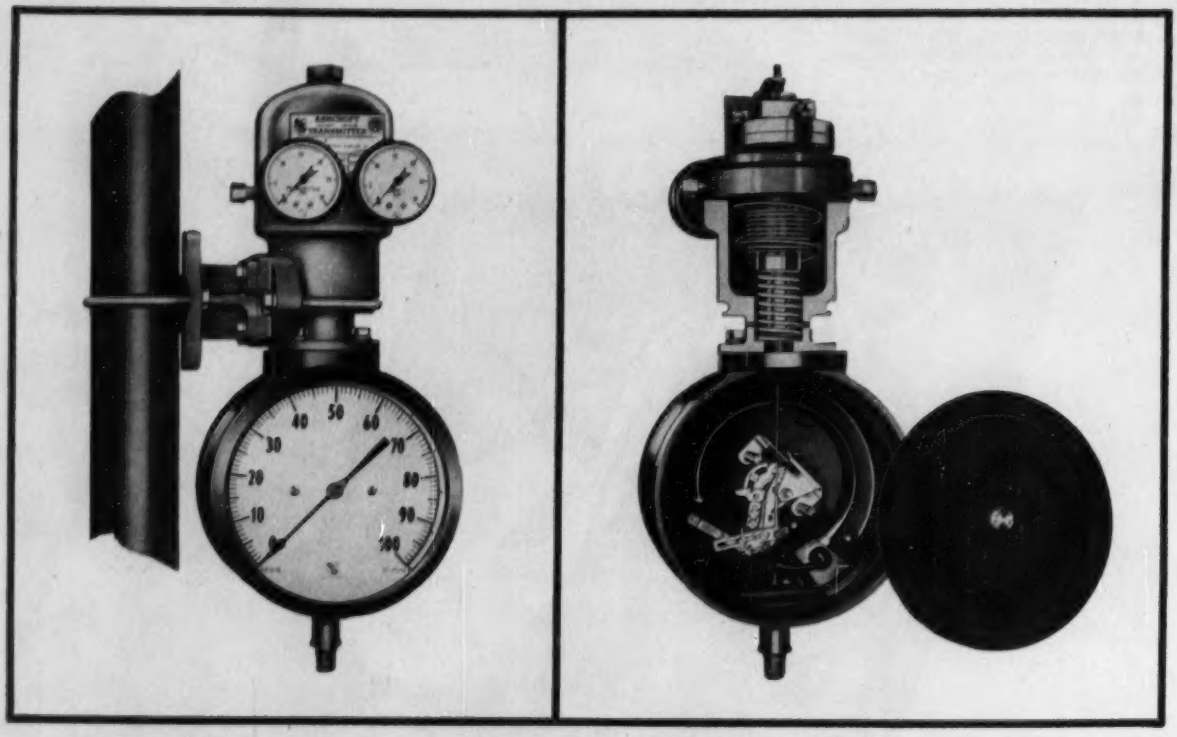
Designed to solve safety and service problems

...THE NEW ASHCROFT PNEUMATIC PRESSURE TRANSMITTER



This new Ashcroft Pneumatic Pressure Transmitter is particularly recommended to processing industries and power stations. It combines speed and accuracy with maximum protection and serviceability.

The new design features the 6" indicating Ashcroft Maxisafe Duragauge, long known for dependable performance. It has an integrally-cast solid metal wall between dial and pressure sensitive element so that the transmitter can measure pressures up to 100,000 psi with complete safety for personnel and equipment. If misapplication ruptures the Bourdon tube, the Teflon-coated back cover serves as a safety blowout relief.

Another outstanding design advantage is easy access to both gauge and transmitter sections. Simply remove the safety-relief back cover and both the gauge and transmitter can be calibrated. Yet a sealed housing makes the entire assembly weatherproof.

The transmitter operates on low-pressure air. No need for expensive high-pressure lines and fittings. Supply air pressure as low as 18-20 psi for 3 to 15 psi output provides especially advantageous operation where electrical wiring might be a hazard. Inflammable, poisonous or corrosive liquids or gases are confined close to their source, away from the central control point.

The Series 1250 Ashcroft Pneumatic Pressure Transmitter is available with pressure sensing elements in all standard pressure ranges and Bourdon tube materials. Installation of the transmitter is easy. Small diameter tubing may be used, and the pipe, stem, wall or flush mounts are interchangeable in the field. Get complete operational data and construction details. Write for Bulletin 340.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR has the broad knowledge and thorough experience essential to satisfy every requirement of your Ashcroft Pneumatic Pressure Transmitter application. You get fast, economical service from his local stocks.

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As a leader in the design and fabrication of petroleum and petrochemical process equipment, The M. W. Kellogg Company assumes many extra curricular responsibilities which eventually benefit not only its customers but the process industries in general. One of these responsibilities is Kellogg's participation in technical committees of professional societies and associations, particularly at subcommittee working levels.

At present, M. W. Kellogg's engineers, metallurgists and others give a considerable part of their time to over seventy such activities . . . ranging from boiler and pressure piping codes to welding practices and radiographic testing techniques. Many of today's accepted design concepts were introduced to the engineering profession by Kellogg committee men.

The M. W. Kellogg Company is privileged to contribute increasingly to the important work of technical and engineering societies, associations, and related groups. The practical application of the knowledge imparted and gained is another plus which goes into Kellogg's "built-in engineer" approach to process equipment design and fabrication. A typical example is a paper prepared by M. W. Kellogg engineers, "Collection and Correlation of High Temperature Hydrogen Sulfide Corrosion Data," and presented at a recent meeting of the National Association of Corrosion Engineers. *Write for your copy.*

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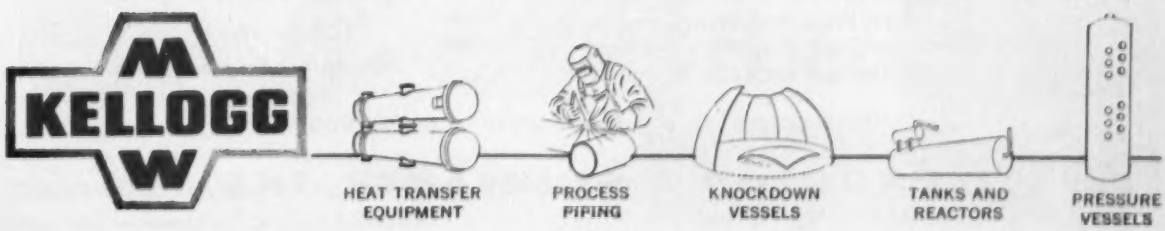
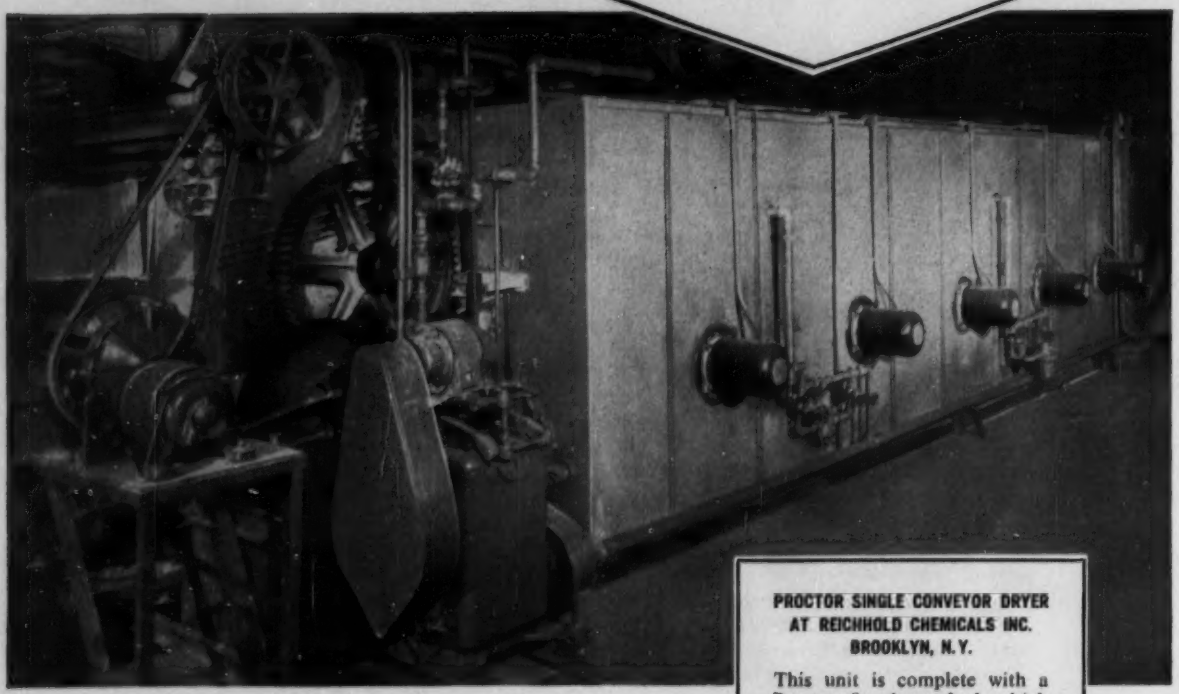


IN EVERY INSTALLATION

Proctor Drying Ranges

offer:

Highest Drying Uniformity
Consistent Product Quality
More Profitable Operation



PROCTOR SINGLE CONVEYOR DRYER AT REICHHOLD CHEMICALS INC. BROOKLYN, N.Y.

This unit is complete with a Proctor fin drum feed which preforms pigment into sticks of uniform thickness and deposits them directly onto the conveyor dryer.

In every installation, Proctor Drying Ranges provide higher drying speeds resulting in increased yields, and profits. Proctor equipment offers the control and flexibility essential for uniform drying, insures consistent high product quality.

Many wet-solid materials heretofore considered unsuitable for conveyor drying can now be handled efficiently by means of Proctor pre-forming techniques. And, as always, Proctor equipment carries performance guarantees based on wide experience and careful analysis of the requirements. Write for complete information.

PROCTOR DRYING EQUIPMENT FOR FOOD AND PROCESS INDUSTRIES

Tray Dryers

Truck Dryers **Pre-forming Feeds**

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Manufacturers of Industrial Drying Equipment and Textile Machinery

The Mark of *Better Filtration*

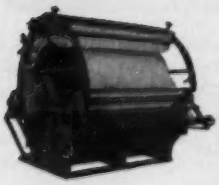
Tear a small piece from the continuous sheet of cake coming from a FEinc String Filter. Turn it over in your hand. In the closely spaced grooves you'll see why FEinc gives better filtration . . . on jobs ranging from thick fibrous cakes to thin sticky slimes.

The strings literally lift the cake out of the weave of the cloth. No scraper to wear, smear or plug the fabric. The cake is dryer, too. Cleaner cloth aids filtrate removal, with less vacuum. No "blow-back" is needed to loosen the cake, hence no filtrate is blown back into the cake. If FEinc's Compression Dewatering Mechanism is added, you get 2 to 6% more moisture out of the cake.

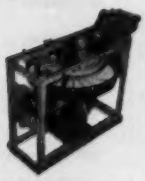
It all adds up to higher yield with FEinc: Cleaner, more workable cake . . . higher recovery of solubles . . . higher filtration rates with a smaller filter . . . extra savings in reduced "down-time" and longer cloth life.

The Original String Discharge Filter is now only one of many types of FEinc continuous rotary vacuum filters available . . . custom-made at standard costs. Write for bulletins today, or ask for performance studies. No obligation, of course.

48



STRING



HORIZONTAL

SCRAPER

CUSTOM DESIGNED CONTINUOUS FILTRATION

FEinc *For a Bigger Yield*

FILTRATION ENGINEERS, INC.
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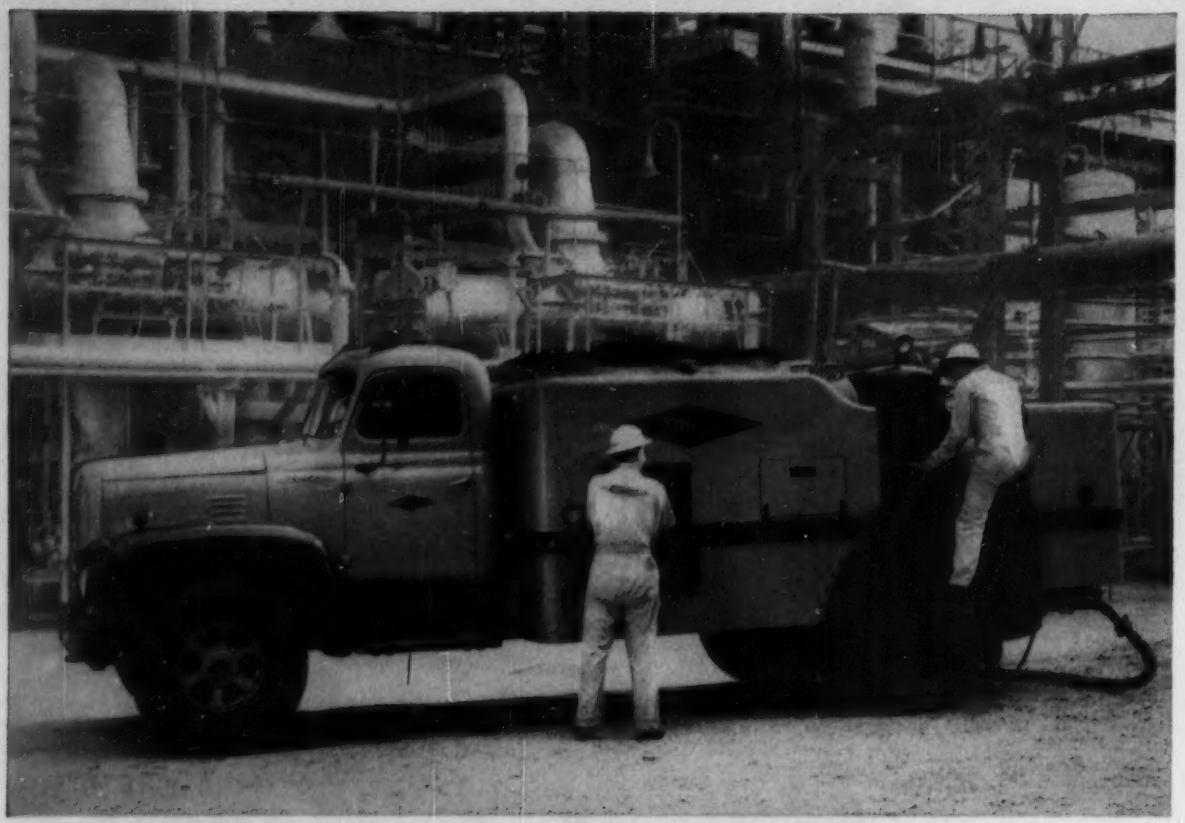


Dowell's Special Tank Trucks, equipped with proportioning and pumping equipment, bring solvents for chemical cleaning of industrial equipment to plant sites.

Monel handles dilute HCl day-after-day

in Dowell equipment-scrubbing units

When processors find it necessary to clean the interior surfaces of large industrial equipment of rust and scale, they often use the means provided by Dowell Incorporated. Dowell brings tank trucks to the plant site and pumps solvents through the equipment to dissolve and sweep away any deposits. The solvent usually has a dilute hydrochloric acid base; sometimes others are used. To prevent the equipment from corroding, the solvent contains specific inhibitors and is introduced under strict control of temperature and exposure time.

Pumps posed difficulty

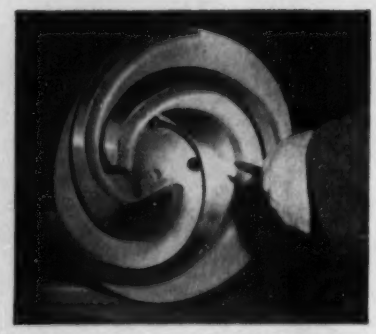
The centrifugal pumps used to circulate the acidic solvent posed a real problem to Dowell. Centrifugal force and high velocities stripped protective coatings from impellers and nullified the effect of inhibitors inside the pump. A need was indicated for parts of durable, corrosion-resisting metal. Dowell's tests of many materials gave an answer . . .

Monel® nickel-copper alloy

Monel alloy, with its inherent resistance to dilute hydrochloric acid, is used by Dowell for pump impellers, stuffing box seals and shaft sleeves as well as for certain storage tank accessories.

You, too, may find Monel nickel-copper alloy an answer to your difficulty. Get the facts. Ask for Bulletin T-29, "Resistance of Nickel, Monel and Other High Nickel Alloys to Corrosion by Hydrochloric Acid, Hydrogen Chloride and Chlorine." It's yours for the asking.

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.



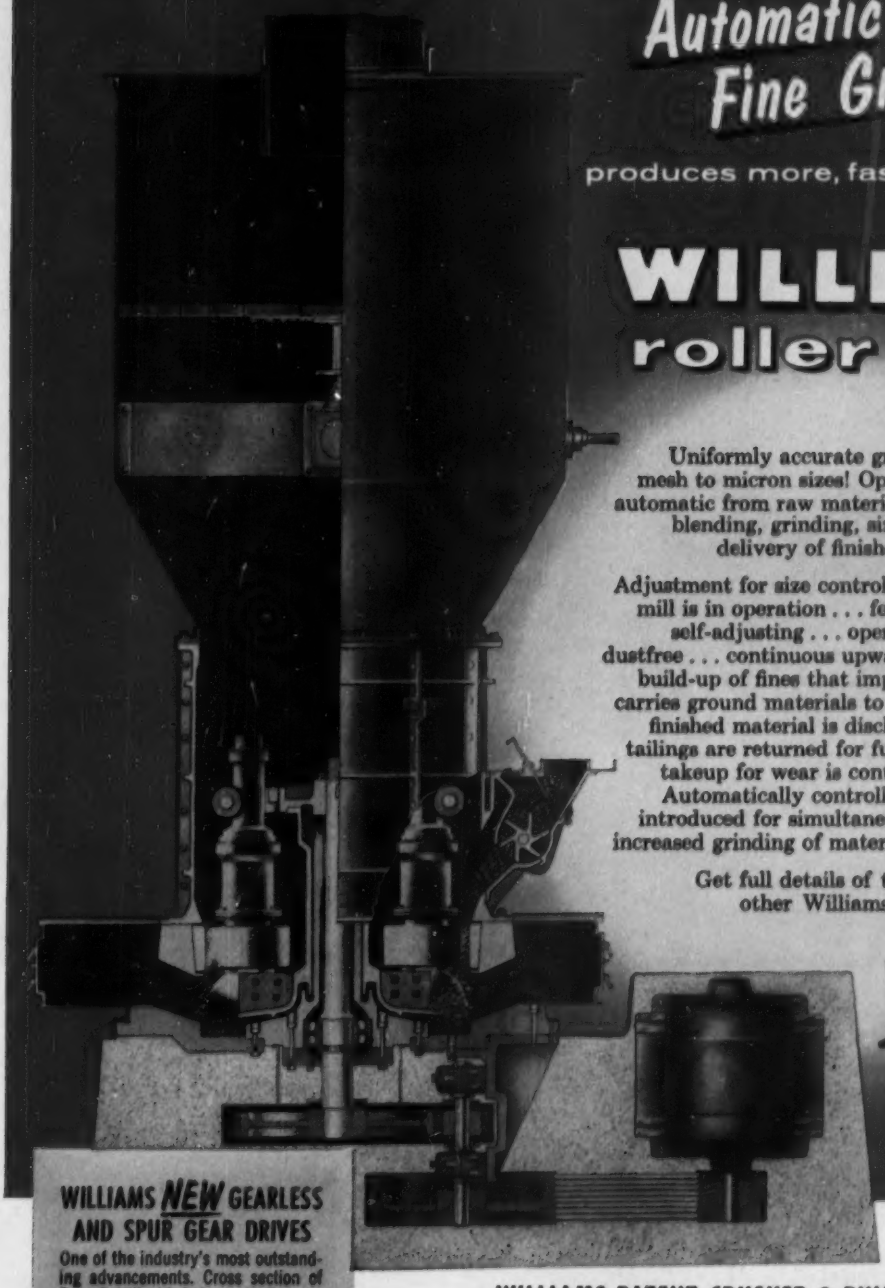
Heart of a "Chemical Brush"...Monel nickel-copper alloy impellers like this are used in Dowell's pumps to introduce cleaning solvents into industrial equipment. They find that parts made of this alloy resist acidic and caustic solutions used in their operations.

INCO TRADE MARK **Castings...** *Sand, Centrifugal and Precision*

Automatic Precision Fine Grinding

produces more, faster and cheaper

WILLIAMS roller mills



Uniformly accurate grinding—from 20 mesh to micron sizes! Operation is completely automatic from raw material feed through blending, grinding, sizing and delivery of finished product.

Adjustment for size control made instantly while mill is in operation . . . feed rate is entirely self-adjusting . . . operation is completely dustfree . . . continuous upward air current prevents build-up of fines that impair operation, and carries ground materials to classifier where finished material is discharged and oversize tailings are returned for further grinding . . . takeup for wear is continuous and automatic. Automatically controlled hot air can be introduced for simultaneous drying and increased grinding of materials containing moisture.

Get full details of these and many other Williams features . . .

Write for NEW catalog

WILLIAMS *NEW* GEARLESS AND SPUR GEAR DRIVES

One of the industry's most outstanding advancements. Cross section of Type D Mill with Spinner Air Separator shows spur gear and pinion drives used on Standard and larger sizes. (Smaller sizes use no gears but have V-belt drive). This type drive is simpler and easier to maintain than bevel gear drives and prevents leakage of material into gear lubricant. Bearing alignment of central shaft is simplified with only two bearings, the bottom one carrying thrust as well as radial loads. Note flow of material being ground by rolls rotating against bull ring, then air swept to separator which discharges fines; returns coarse material for regrinding.

WILLIAMS PATENT CRUSHER & PULVERIZER CO.

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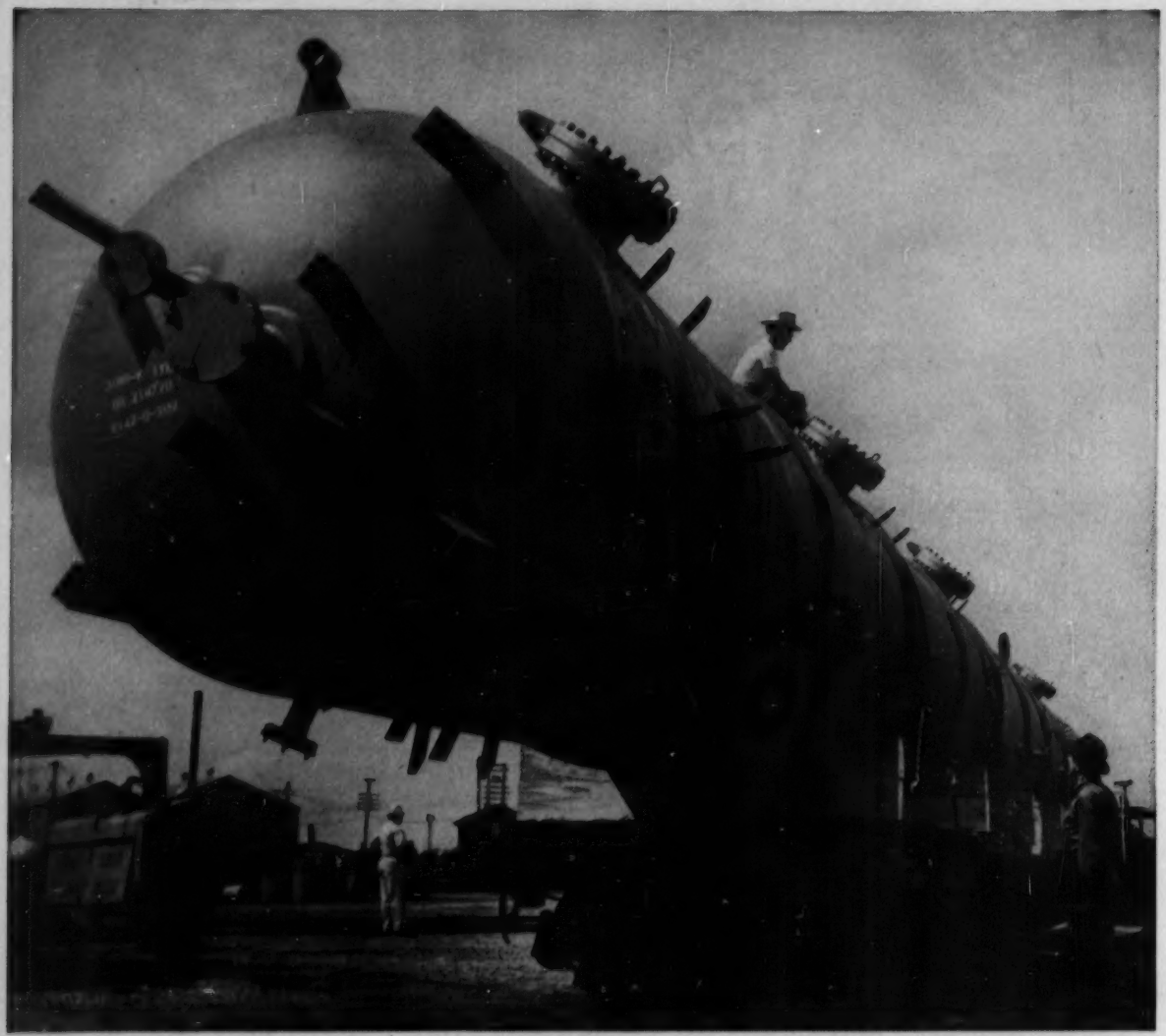
CRUSHERS GRINDERS SHREDDERS

Hammer Mills Helix-Seal Mills Air Separators Vibrating Screens Feeders Impactors

OLDEST AND LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD



THIS ENTIRE VESSEL was radiographed. Built for use by Socony Mobil Oil Company, Incorporated, it was stress relieved in thirds, and the two joints were stress relieved locally. The unit contains 30 uniflex trays of 96" diameter. Overall weight: 152,000 lbs.

Among the largest in use

...built by Newport News

This Debutanizer with a 110 feet 6 inches over-all length is typical of units that are readily built by Newport News . . .

In fact, Newport News can fabricate almost any type of pressure vessel or other heavy equipment used in the petroleum, chemical or other processing industries.

But at Newport News you'll find more than large productive capacity.

In vast fabricating shops, in huge machine shops, foundries and forging plants, Newport News craftsmen complete your order with specialized techniques. Plant methods . . . developed as a result of specializing for more than half a century . . . enable Newport News to provide money-saving answers to all sorts of heavy equipment problems.

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PROTECTION...
PERMANENCE...

GET ALL 3 WITH LAPP TUFCLAD®

SOLID CHEMICAL PORCELAIN ARMORED WITH FIBERGLASS-REINFORCED PLASTIC

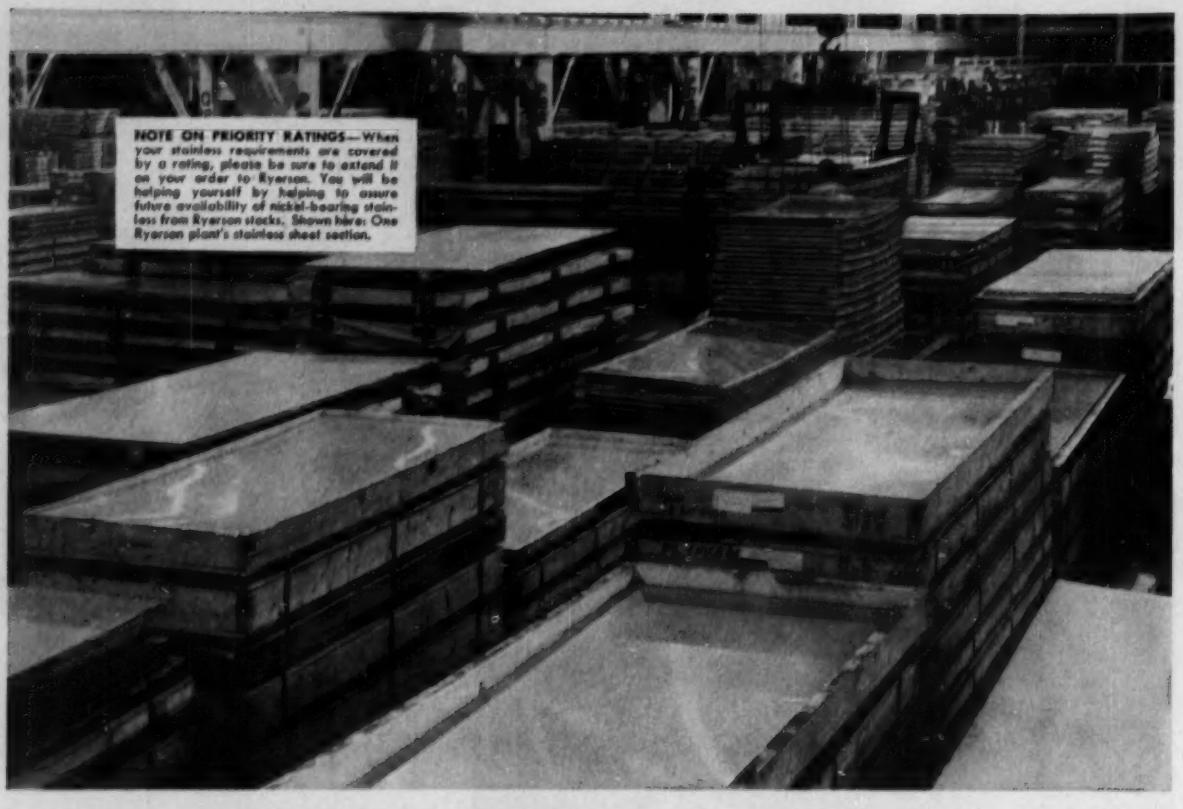
Y-Valves as shown, and Angle Valves are available in Lapp TUFCLAD Chemical Porcelain in ½" to 6" sizes. Also safety valves, flush valves, plug cocks, pipe and fittings (to 8" diam.) and special shapes.

Lapp Chemical Porcelain is the ideal material for maintaining strict purity control of product because of its many special characteristics. It is chemically inert, therefore resistant to corrosion from acids of all concentrations (except hydrofluoric); it's hard, dense, pure, homogeneous, close-grained, non-porous.

Now, add the low-cost protection offered by TUFCLAD—an armor consisting of multiple layers of strong fiberglass fabric impregnated and bonded to the porcelain with an Epoxy resin of high strength and chemical resistance. TUFCLAD armor serves as an insulator against thermal shock—a cushion to accidental impact, and is tough and strong enough to hold operating pressures even if porcelain is fractured. This protection to personnel, equipment and product—the purity of Lapp Chemical Porcelain—and low maintenance costs due to the permanence of a Lapp TUFCLAD Chemical Porcelain system merit your investigation.

WRITE for description and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 804 Wendell St., Le Roy, New York.

Lapp
CHEMICAL PORCELAIN


NOTE ON PRIORITY RATINGS—When your stainless requirements are covered by a rating, please be sure to extend it on your order to Ryerson. You will be helping yourself by helping to assure future availability of nickel-bearing stainless from Ryerson stocks. Shown here: One Ryerson plant's stainless sheet section.

for STAINLESS, call Ryerson...

Ryerson stainless bar stocks include free-cutting types, aircraft quality bars—many others.

Any shape can be accurately flame cut from stainless plate with special Ryerson plate burning equipment.

More than 300 miles of stainless pipe and tubing are on hand at Ryerson. Size range: ⅛" through 8⅝" O.D.

Felt pads on Ryerson shears protect the beautiful finish and flatness of Allegheny stainless sheets during cutting.

here's why:

your call to Ryerson connects you with the nation's largest stocks of stainless steel—2,351 sizes, shapes, types and finishes of time-tested Allegheny stainless—carried in tonnages that assure prompt shipment of your warehouse requirements.

. . . you get the benefit of Ryerson's long experience with stainless—30 years of it, dating from the days when Ryerson pioneered as the first supplier of stainless from stock. All we've learned in that time is at your command when you want help on problems of stainless application or fabrication.

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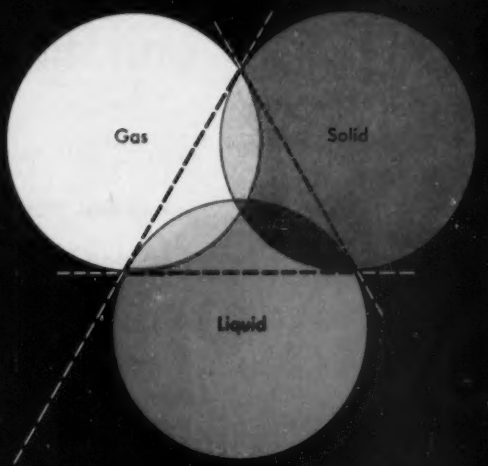
Chemical Engineering
August 1956



32-page Feature Report

Liquid-Gas Contacting

Reorient your thinking about the contacting operations you use and the commercial equipment that is available.

RAYMOND E. VENER, Catalytic Construction Co., Philadelphia, Pa.

OPERATIONS that involve the contact of liquid with gas are vital to the chemical, petrochemical and petroleum industries. These operations are becoming increasingly significant in the metallurgical, atomic energy and other industries as well.

What are the liquid-gas contacting operations? How are they linked with other chemical engineering operations? What equipment is available for carrying them out? And is the concept of a related group of liquid-gas contacting operations something new? Or is it just a more profitable way to use the engineering knowledge that is already available?

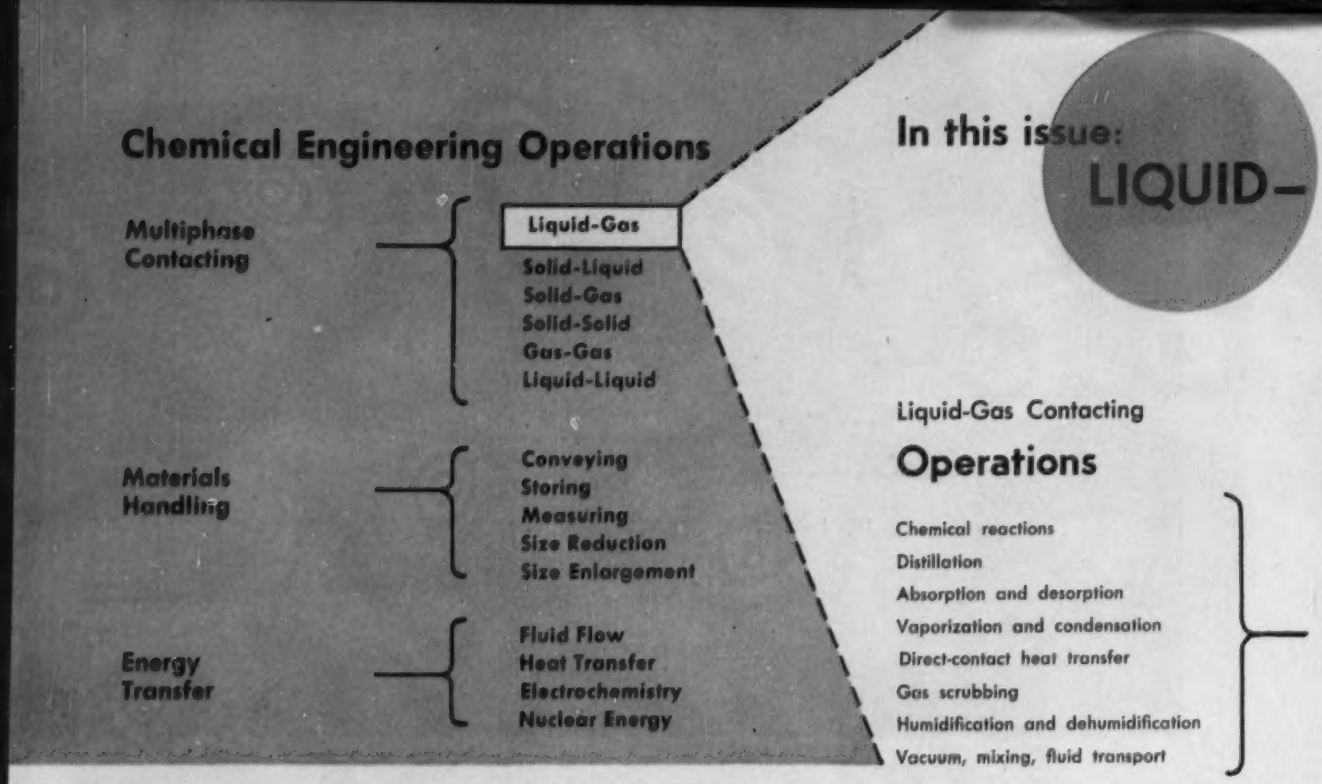
This 32-page Feature Report will supply the answers to these questions.

The familiar and almost classical depiction of chemical engineering in terms of unit operations and unit processes has served admirably in its development as a separate field of engineering. However, a reorganization, simplification and systematization of the many apparently-new unit operations and unit processes is long overdue.

If the chemical engineering profession is to continue to develop to its full potential and to expand its services to the many process industries that are now calling for them, we must be able to take full advantage of important technical developments in these industries. To achieve this it is important that we have a simple—but effective—organization of operations and technology. This is essential for the interchange of technical information among these fields and to reduce unnecessary duplication of effort along parallel lines.

Surely, we are all aware of the natural—but regrettable—tendency in all industries to develop and to use nomenclature and operating practices that are unique to one particular industry. It is an understatement to say that this makes interchange of information somewhat difficult.

Indeed, it would be difficult to overemphasize the advantages that can be gained from adequate systematization and interchange of process technology. Systematic interchange leads to: improved commercial operation; more effective engineering education and industrial research; and



the design of new or improved equipment. As a step toward the effective reorganization of technological operations, we propose the concept of liquid-gas contacting as a broad unit operation, one of several permutations of multiphase-contacting operations.

The Original Concept

The original concept of chemical engineering resolved manufacturing processes where certain either chemical or physical changes of materials are involved into a coordinated series of unit physical operations and chemical unit processes. The concept of the unit operations as a series of building blocks with which we can characterize a sequence of manufacturing operations has been applied and extended by chemical engineers for over three decades. It has been the firm foundation upon which chemical engineering—as we know it today—has been built.

However, the concept of unit processes has proven to be a relative failure even though several texts are based on it and reviews are published periodically covering an ever-increasing number of so-called unit processes.

Why has this concept failed? Here are some of the reasons:

• Most of the so-called unit processes involve organic reactions where kinetics are controlling. In spite of wishful thinking on the part of some optimistic researchers, the status of applied reaction kinetics is still in the embryonic stage and this is certainly not the basis upon which commercial equipment is designed. Progressive scale-up and pilot-plant work are adequate evidence of the ignorance factors involved in this area. Substantial progress has been and is being made in the field of applied reaction kinetics. But we stand only on the threshold of knowledge.

• The unit processes can actually be resolved in terms of unit operations or divisions of unit operations.

• The infinite variety of possible chemical reactions renders it inevitable that the number of reactions that are commercially important will increase at an accelerated rate. It will be necessary to group these new reactions on the basis of similar chemistry (precisely as has been done in the study of organic chemistry) rather than to hail each one as a new unit process. However, grouping these reactions for the purpose of fundamental study and of characterizing the reaction kinetics is one thing. Treating each of these separately from a chemical engineering viewpoint is quite another. Agitators, heat transfer elements, reaction vessels, distillation sections, etc., certainly are not related to any particular reaction. The very fact that much commercial equipment is designed and used for many multipurpose uses helps to prove this point.

Physical Can Be Chemical

This is a good place to point out that the additional factor of reaction kinetics is also encountered in many of the unit operations. In fact, unit operations quite often involve chemical as well as physical changes. This will become more evident as we consider the various multiphase-contacting operations (see table above). Perhaps, it is most obvious in solid-gas operations.

Reactions such as oxidations, reductions, halogenations, sulfatizations, miscellaneous thermal decompositions and even many so-called drying operations involve basic chemical changes in solid composition. Depending on the particular operation involved, reaction kinetics may or may not be the limiting factor in sizing the equipment required to provide the required retention time. It serves no useful purpose to draw a demarcation line in a drying operation, designating it as a unit operation as long as the water being removed is unbound moisture, and calling it a unit process when the water being evolved

—GAS Contacting

Liquid-Gas Contacting Equipment

- Tray columns
- Packed columns
- Spray units
- Jets
- Vaporizers
- Condensers
- Mechanical contactors

comes from a chemical decomposition of a stable solid compound.

We could cite many other examples that demonstrate the fallacy of using an arbitrary line of demarcation between chemical and physical processing as the basis of a classification scheme for chemical engineering.

Chemical reactions are often involved in liquid-gas contacting operations although these are generally presumed to be exclusively physical operations. The absorption of carbon dioxide gas in caustic solution is a well-known example. Similarly, many other absorption reactions such as the production of nitric acid by absorbing NO and NO_2 in water are very definitely chemical in nature. Indeed, it is difficult to conceive of absorption operations that do not in some way involve chemical association between the absorbed gas and the liquid that does the absorbing. There probably are none.

There are also numerous examples in the field of distillation. Chemical kinetics are very definitely involved in the separation of mixtures of formaldehyde, methanol and water.

Grew Like Topsy

The unit operations originally considered by chemical engineers were few in number. Unfortunately, there has been a tendency to hail, as a new chemical engineering unit operation, each innovation or modification of contacting or separating techniques. Typical examples of so-called new unit operations are: fluidization, ion exchange, leaching, dialysis, moving-bed methods, flash techniques, etc.

While such claims may have some advantage as sales material for manufacturers' literature—and may provide some support for new claims in patent applications—the result is confusing.

Must Be a Better Way

This can not go on indefinitely. There must be a better way of classifying the operations of chemical engineering. We have indicated our preference in the table above. The table indicates, without giving detailed explanations, a logical scheme for grouping all chemical engineering operations. It is based on permutations of binary-phase contacting. Naturally, the extension of multiphase grouping to include more than two phases is not excluded from this proposed classification scheme.

However, it is not recommended unless it distinctly adds something for the purposes of education, research, development, engineering design or equipment selection. When three or more phases are involved in an industrial operation, we can probably select two of them as being the most significant ones for purposes of classification.

Note that in specifying the various permutations of contacting liquid, gas and solid, three stages are actually implied within our boundary conditions:

1. There is the introduction and mixing of the two phases.
2. There is retention within the contacting equipment to create a more valuable and a less valuable material.
3. There is a separation of the more valuable material.

For practical purposes, of course, provision for introduction, mixing and separation are just as important in the design specifications for an item of commercial equipment as is the size required to provide the necessary retention time during contacting. For example, in flash dryers, spray units, fluidized-solids equipment, etc., the efficient mixing of solids and gases as well as the subsequent separation of the solid and gaseous products are as important in the over-all design as the specification of a desired retention time.

In bubble-cap distillation columns, sieve-plate towers and mixer-settler extraction units, etc., there are numerous separate and distinct mixing, retention and phase-separating operations within a given unit.

Resistance to Change

A previous Feature Report by the author (*Chem. Eng.*, May 1955, p. 163) pointed out that there was considerable inertia and reluctance on the part of many industries (chemical, petrochemical, petroleum, metallurgical, etc.) to evaluate objectively the relative merits of alternate operations and the equipment that is available for conducting them.

Consequently, in practically all industries the choice of equipment for conducting operations such as drying, calcining, roasting and catalysis is often governed more by custom and personal preference of the designers than by truly comprehensive and thorough comparison of the relative merits of alternate techniques. Such an objective evaluation of alternate techniques can hardly be left to the vendors of competitive equipment.

The responsibility for objectivity rests squarely with the design and operating engineers.

The resistance to change is not restricted to solid-gas operations. It is equally prevalent in liquid-gas contacting. The major impetus to the development of more efficient distillation equipment was given by the petroleum industry. But even here, there is a natural tendency to consider the province of petroleum technology as so specialized a subject that there is no need for interchange of ideas, data and equipment with other process industries.

In spite of all the excellent and comprehensive work conducted in the field of distillation, a great deal remains to be done. Practically all equipment is still designed on an empirical basis even though we are beginning to understand more of the theory.

We do not want to infer that all of the liquid-gas contacting operations can be conducted in any one of the equipment types that are

available. However, the basic features inherent in many of the liquid-gas contacting units can be used to advantage in several of the contacting operations—with appropriate adjustments in design for particular commercial applications, of course.

The types of contacting equipment used for absorption and distillation, such as the various packed and tray columns, are very similar. Adaptations of many of these units can be used for such apparently unrelated operations as heat transfer and the removal of dust and fumes from gas streams.

Similarly, the jet principle can be applied to creating vacuum, conveying fluids, mixing and even as the basis for mixing devices within distillation and absorption equipment.

What Contacting Includes

It should be noted that the term *contacting* as used in this Report is used in its broadest sense and pertains to the major equipment and its direct accessories. To conduct an operation such as distillation in a bubble-cap column obviously involves a complete integration of: mixing the two phases one or more times; providing the required retention time for the two phases to be in contact; and providing a means for separating the two phases after each of the contacts.

There are two other categories under the general heading of liquid-gas operations. These are mixing and separating. This applies also to each of the other pemutations of liquid, gas and solid contacting. However, the relative importance of the mixing and separating operations will vary with the particular combination of phases present.

The purpose of setting off mixing and separating as separate categories is that there are many instances where these operations are separate and distinct from any others.

For example, in the field of air conditioning, effluent gas treatment, etc., it is often necessary to scrub solids and fumes either for the purpose of providing comfort or clean process air. Gas scrubbers, which are liquid-gas contacting devices, may be used. But their function is primarily that of separation of solids (or liquids) from gases. Retention time and mixing are not critical in this equipment. Similarly, gas jets may be used to give mixing without mechanical agitation.

Thus, under each of the combinations of phases we should consider one prime division, *contacting*. In addition there are the two lesser divisions, *mixing* and *separating*, whose importance depends on the system of phases. Mixing of solids is a very important problem and involves a tremendous variety of equipment. On the other hand, mixing gases is a very simple matter. But separation of gases by such methods as gaseous diffusion is quite difficult.

You will probably notice that our classification scheme ignores the concept of *diffusional operations*, which has not met with any real degree of success from either a practical or a theoretical point of view. In the operations where mass transfer phenomena are important, there are innumerable instances where diffusion is not the rate-controlling factor.

This, in addition to the fact that other than for diffusion of gases through gases, there is no adequate theory upon which to base such an approach. Mass transfer in liquid and solid states is so complex that no truly scientific basis is available for dealing with them quantitatively. All present design methods —regardless of pretensions of theoretical foundations—are actually still empirical.

Broad predictions regarding the inevitable scientific bases for all chemical engineering operations, as set forth by some academic and industrial prophets, conveniently ignore pressing problems that must be coped with now and in the near future. No one would question the desirability of such an efficient and effective scientific base but the present projections appear to be unrealistic.

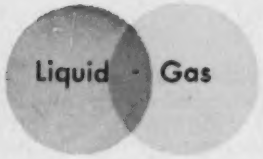
What We May Gain

We hope that this classification will stimulate efforts that will:

- Develop a more fundamentally sound theory for the operations of chemical engineering.
- Encourage research by physical chemists and/or chemical engineers in concentrated physical chemistry rather than the use of invalid extrapolations of data and laws from dilute physical chemistry.
- Evolve a more practical equilibrium concept, which in many cases may be an apparent rather than a true thermodynamic value.
- Use a more realistic concept of driving forces with pointwise design rather than over-all end-value driving forces.
- Provide a uniform nomenclature for comparable operations.
- Exchange data and technology among the various industries that use contacting operations.
- Recognize the fundamental capabilites that have been designed into commercial equipment to help it carry out similar contacting operations.

RAYMOND E. VENER concentrates his chemical engineering activities in the fields of extractive metallurgy and atomic energy. As a full-time process consultant and process engineer with the Catalytic Construction Co. in Philadelphia, he has since 1951 been involved in the sales and design side of many of the atomic energy, petroleum, metallurgical, chemical and petrochemical plants that Catalytic has worked on. The atomic energy work at Catalytic has included milling raw and feed materials, separation of isotopes, reprocessing of spent fuels, design of power reactors and other chemical engineering problems.

Dr. Vener received his Ph. D. from the Univ. of Pennsylvania in 1948 and has been actively consulting on atomic energy projects since 1942. In 1949 he joined Drexel Institute of Technology to teach graduate courses and direct graduate research. He somehow still manages to make time for his graduate students at Drexel Institute while working fulltime at Catalytic Construction.



Contacting

Operations

IN THIS section we will outline in as much detail as space permits some of the fundamental similarities and differences of liquid-gas contacting operations.

No attempt has been made to include a detailed discussion of liquid-gas separating except insofar as liquid-gas contacting methods are used to effect a separation of fumes, dusts and entrained liquids. The general subject of entrainment separation has already been covered in a recent *Chemical Engineering* Report (Oct. 1953, p. 213).

Neither will we dwell on the subject of condensate removal, a particularly important liquid-gas separating operation. Design of appropriate traps for the removal of condensate in distillation, evaporation or other operations is best treated in a separate article emphasizing the mechanical rather than the process design features.

For operations of liquid-gas mixing, a broad array of atomizers, sprays, ejectors, distributors and mechanical devices have been designed. They are generally an integral part of most commercial contacting equipment and special designs can usually be furnished for unusual applications. A number of manufacturers specialize in the development and production of such devices.

However, it is beyond the scope of this Report to discuss these distributing and mixing operations in any detail.

Instead, we will concentrate our efforts on examining and appraising what we know today about the fundamentals of the following liquid-gas contacting operations:

- Chemical reactions.
- Distillation.
- Absorption and desorption.
- Vaporization and condensation.
- Direct-contact heat transfer.
- Gas scrubbing.
- Humidification, dehumidification and water cooling.
- Vacuum production, mixing and fluid transport.

Although this tabulation includes most of the important liquid-gas contacting operations, it is not necessarily complete. Undoubtedly, other operations can be added. However, the vast majority of these other operations can be absorbed under the headings listed above.

In the ten pages devoted to this discussion, it will hardly be possible to delve deeply into the fundamentals of each of the liquid-gas contacting operations. Any one of them could be—and several of them have been—the subject of a Feature Report in itself.

We will try to point out those areas where we need more information, appraise the information that is publicly available today and suggest some fundamental work that ought to be done on a priority basis. Our opinions, as they may be expressed in the discussion that follows, have evolved from teaching these operations to undergraduates, directing graduate research on these operations, directing industrial research, and in designing commercial-scale plants.

Chemical Reactions

Probably the most important chemical engineering reason for contacting liquid with gas is to carry out a chemical reaction. These operations have been collected and classified as unit processes.

Many of the so-called unit processes involve catalyzed or uncatalyzed heterogeneous reactions in a two-phase liquid and vapor system. The catalyst may be present as solid suspended in the liquid phase. The fundamentals of maintaining intimate contact of liquid and gas phases are directly related to other liquid-gas contacting operations.

As we mentioned in the introduction to this Report, there is no logical reason for designating such processes as *units* on the basis of reactants or products. The obvious interrelation of chemical and physical phenomena makes it completely unsound and impractical to erect an artificial barrier between them in describing commercial operations. A liquid-gas nitration reaction involves not only reaction kinetics but also conveying and treating materials, mixing, heat transfer, separation of materials, filtration and distillation.

Liquid-gas contacting operations where chemical reactions occur include a very large segment of all commercial processes, with many different rate-controlling mechanisms. The actual reaction may take place in either phase or at an interface separating the liquid and gas phases. In addition, we have problems of mass transfer of reacting materials from one phase to another or to an interface.

Thus, the net rate of reaction is controlled by a series of steps, such as chemical kinetics and mass transfer. The rate-controlling step is a function of the particular system involved, catalysts, conditions of operation and other factors.

Although chemical reactions, unit operations and plant design may be segregated for purposes of study and research, practical engineering design, construction and operation involve their thorough integration.

The translation of fundamental data to design of commercial equipment still requires empirical techniques based on a progressive scaleup of pilot-plant operations, generally on each individual system. As the relationships of mass and heat transfer, reaction kinetics and equipment performance become better understood, the amount of such pilot-plant work will be minimized.

In the meantime, considerable progress can be made by full appreciation of the advantages and limitations of alternate techniques for contacting liquid and gas phases. To this end, it is hoped that industry might make available and publish more reliable plant-scale operating data on various chemical processes—within a realistic framework of nonconfidential information.

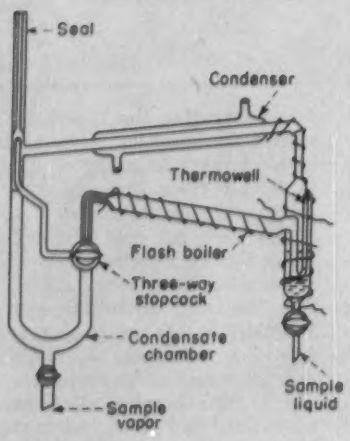
Distillation Operations

Distillation is probably the single most important liquid-gas contacting operation in the field of chemical engineering. It is certainly the one on which the most effective—and voluminous—fundamental as well as applied studies have been conducted. Still, while much progress has been made in the field of distillation, the basic phenomena are still not well understood. This is illustrated by several programs now under way aimed at elucidating fundamental principles involved in the operation of commercial-scale distillation equipment.

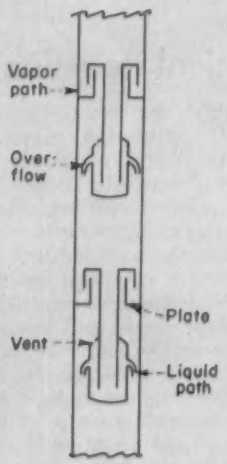
There is a great deal to be gained by thorough interchange of information and data on laboratory, pilot-plant and commercial-scale installations that involve contact of liquid and gas phases. However, this exchange should be made on a logical and systematic basis. In some instances, bubble-cap, sieve-plate and packed-column distillation designs have been used with very little modification and questionable efficiency for other operations such as absorption and gas scrubbing. Even for distillation applications alone, it is often difficult to select the most suitable method for normal design problems.

Complex distillation operations are far more difficult. Consequently, we can expect that inteiligent interchange of technology about various contacting devices for different liquid-gas operations will require much more work.

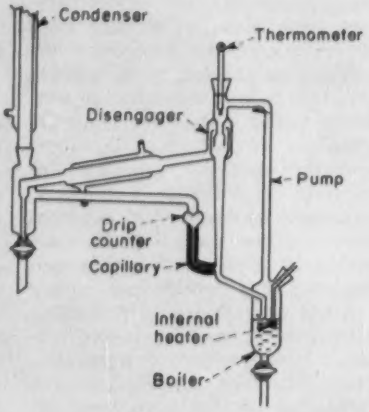
Designing for commercial distillation operations requires equilibrium data plus information on mass-transfer efficiency and allowable fluid-flow rates through various contactors. One of the most critical limitations in distillation design —which is now becoming more appreciated—is the limited availability of reliable equilibria data.



Colburn Still



Othmer Column



Gillespie Still

Equilibrium Data Vary—Even from the Most Reliable Sources

There are various laboratory methods for obtaining vapor-liquid equilibrium data. The circulation method involves circulating the vapor through a system and bringing it into repeated contact with the liquid until no further change in composition occurs. This method is one of the most precise but involves a number of experimental complications.

Batch bomb methods appear simple but involve serious difficulties in sampling. The transpiration method involves passing a vapor through a series of vessels containing liquids of suitable composition. The number of vessels used are such that the vapor entering the final unit is of essentially equilibrium composition. The system is simple basically but does not provide exact equilibrium data because of pressure drop.

Dew and boiling point methods are limited to binary systems and require a relatively large amount of very precise experimental work.

The simplest dynamic method is the distillation of a very small amount of vapor from a flask containing a large quantity of liquid. Successive samples of condensate can be collected and a plot of composition vs. quantity of distillate extrapolated back to zero distillate to obtain composition of vapor in equilibrium with the original charge.

Various modifications of the Othmer column have developed. These involve boiling a liquid, condensing a vapor sample, and recycling condensate back to the still. The same major question arises for this, as in the case of simple dynamic distillation, whether the vapor produced from the boiling liquid is in equilibrium with that liquid. Recent critical studies of the mechanisms of such recirculating-boiling stills indicate that the steady-state condition can easily involve serious deviation from true equilibrium.

The Colburn still shown above combines elements of the transpiration technique with dynamic methods. The Gillespie still involves circulation of both vapor and liquid.

Since very few systems form ideal solutions, we must obtain vapor-liquid equilibrium data for practical design. An impressive volume of data have been published on equilibrium relationships of various systems using numerous laboratory techniques. There is serious doubt about the validity of most of these data, both from a theoretical thermodynamic aspect and for commercial design. (Sketches of three equilibrium stills are shown on p. 180.)

Even for relatively simple binary systems, there is considerable discrepancy among data of various investigators using different stills. In some instances there have been considerable variations for a given system, in spite of the fact that essentially the same laboratory techniques were used. It may be convenient, but hardly objective and fair, to dismiss such discrepancies as faulty work.

When we survey the innumerable studies on tray and column efficiencies aimed at refining design methods, it is difficult to understand why relatively little attention is directed at the validity of the basic equilibria data upon which such efficiency studies must be based. Effects of impurities and temperature variations on even simple binary mixtures can result in appreciable variation in the equilibrium. Multicomponent and complex mixtures are far more difficult to assess.

Ideality As a Norm

The concept of ideal gases and liquids is used as a norm in physical chemistry. Deviations from this norm are expressed as activities and activity coefficients. These are widely used in studies of dilute solutions but appear to have limited value for the concentrated solutions encountered by chemical engineers. However, in view of the lack of any alternate theory, considerable academic work has been directed at extrapolating the activity concept to engineering concentrations.

The Margules, Van Laar, Scatchard-Hammer and other integrated forms of the Gibbs-Duhem equation express the activity coefficients of the components in a binary mixture as functions of liquid composition and empirical constants. They are, in effect, mathematical curve-fitting methods. In studying vapor-liquid equilibrium data to evaluate their validity, plots of vapor vs. liquid compositions and of relative volatility vs. liquid composition merely illustrate the spread of experimental data from a smooth curve. They provide no gage of thermodynamic consistency. These integrated equations help evaluate, correlate and possibly extend experimental data on nonideal solutions.

It should be appreciated that these methods are empirical. Where it is necessary to estimate equilibrium data for systems of commercial importance from a very limited amount of data, these calculation methods may have some value. They have been used with some success in estimating vapor-liquid equilibria relationships from limited measurements of azeotropic compositions, total pressure or boiling point curves, or liquid-liquid solubility. Attempts to extrapolate these methods for extending or predicting equilibria data for ternary and other multicomponent systems have met with little success.

Enthalpy-Composition

Use of enthalpy-composition diagrams in distillation is very limited. First, they are limited to binary mixtures. Secondly, the number of systems for which reliable enthalpy-composition data are available is very limited. Also, even where data are available for a simple binary system, the work of preparing such a diagram is seldom justified where only a few calculations are required. Finally, even if such data were available, they probably would not be used because in most cases other factors such as the precision of equilibria data and

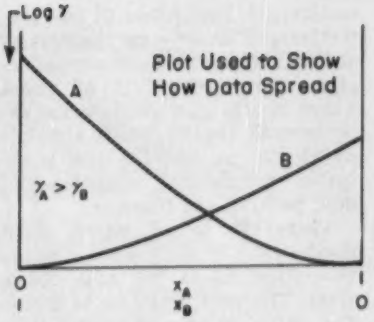


plate efficiencies do not warrant the extra work required to obtain more precise results.

In most instances, there is little if no difference between the enthalpy-composition and the McCabe-Thiele procedures. Unfortunately, the treatments in many textbooks give the erroneous impression that enthalpy-composition diagrams are widely used for commercial design.

Basic equilibria data are equally important for multicomponent, extractive, azeotropic, vacuum, steam and molecular distillation. For such operations there is little advantage in even considering deviations from ideality and the treatments are entirely empirical.

It is clear that vapor-liquid contacting operations are extremely varied and important in distillation. There is a real need for new or improved—and often more simple—methods for conducting flash, batch and continuous distillation operations. There is still an urgent need for accurate equilibria data, reliable calculation methods for interpreting experimental results, and valid bases for translating experimental phenomena to commercial equipment.

Absorption and Desorption

The characteristic which distinguishes absorption from distillation and condensation operations is that it involves the transfer of material from a gaseous to a liquid phase, with the gaseous phase consisting primarily of inert gases.

Desorption involves the reverse operation, the transfer of material from the liquid to the gaseous phase. Desorption operations are often integral parts of absorption processes, as in the successive removal of CO_2 from gas streams, followed by stripping from the solvent with recycling of the latter. Desorption is also used to remove final traces of more volatile components from a solution as in steam stripping in various petroleum refining operations.

Modifications of literally all types of commercial liquid-gas contacting equipment, with the exception of vaporizers, are used for industrial absorption applications.

While absorption is one of the oldest and most important chemical engineering operations, its basic mechanisms are still not well

understood. Regardless of any pretentions of underlying theories of absorption, practical commercial designs are empirical in all cases. There is still no substitute for experimental studies which simulate as closely as possible the anticipated commercial conditions of flow, packing and trays.

There can be no quarrel about the desirability and the use of sound theoretical bases for such operations. The goal would be to design for optimum economic and technical conditions with a minimum of experimental work. While a tremendous amount of data have been published on many aspects of absorption, the most important problem still to be solved is the development of a sound, comprehensive theory.

An Artificial Crutch

The so-called film theory has been used for the past three decades as an artificial crutch. This concept assumes that material is transferred in the bulk of the two phases by convection currents and that concentration differences are negligible except in the vicinity of the interface between the two phases. It postulates that the concentrations of the two phases at the interface are in equilibrium and that the resistance to transfer is due to films on the two sides of the interface, which have negligible capacity but offer most if not all of the resistance to the transfer of mass.

Presumably, turbulence decreases from the bulk of the fluids to a point where flow in the film is considered to be laminar and parallel to the surface. The solute presumably passes through these films only by molecular diffusion.

An inherent error in this theory is the implication that since the resistance is confined to thin stagnant layers through which material passes by molecular diffusion, the over-all rate of transfer should be proportional to the molecular diffusivity. Although the effect is difficult to assess, there is no doubt that eddy diffusion also plays an important role in commercial equipment. The only reason that the film concept is still used at all is that no one has yet developed a better alternate.

It is impossible to conceive of truly stagnant films on the gas and liquid sides of the interface, or of a really uniformly-mixed body of liquid.

Transfer Analogies

Most of the work on analogies of heat, mass and momentum transfer suffers from inherent assumptions that such films exist and that experimental data for one can be translated to others. Although interesting, these analogies are still only of academic significance. Considerable progress has been made on clarifying our understanding of turbulence although it is still very incomplete, particularly as it relates to mass transfer.

It can be stated categorically that for practical purposes, the integration of separate fields of friction, heat transfer and mass transfer in turbulent flow into a single branch of science is still only the reflection of an optimistic gleam in the eyes of academic researchers.

It is true that remarkable progress has been made on the integration and correlation of the kinetic theory of gases with observed experimental and industrial experience. Indeed, the data on diffusion in gases provide impressive confirmation of the validity of the kinetic theory. A tremendous amount of work has been conducted over the past 15 years to add materially to the practical confirmation of the kinetic theory, in conjunction with gaseous and thermal diffusion work on the huge scale necessary for the separation of uranium isotopes.

The translation of technology on gaseous-state diffusion to absorption of gases in liquids involves the assumption that the kinetic theory can be used to explain the transfer of mass through a hypothetical gas film adjacent to the liquid-gas interface. As pointed out above, there is a serious question as to whether such a film actually exists. The application is therefore strictly a matter of analogy and hardly represents basic theory.

Considerable data have been published, expressed in terms of diffusion coefficients. However, the application of these diffusion coefficients or diffusivities, to the design of commercial equipment still calls for an over-all approach that is decidedly empirical.

Obviously, in the case of liquids, diffusion is much slower than in gases because of closer molecular spacing and greater molecular attraction. The kinetic theory of liquids is by no means on a comparably sound basis as is the theory for gases. Attempts to measure and correlate liquid diffusivities have been very unrewarding. The many equations found in print have been derived completely by analogy from the treatment used for gases.

They do not have the slightest semblance of theoretical foundation.

For Practical Design

For practical design purposes the rate of transfer into or out of a moving stream of gas is represented as being proportional to a potential driving force and some function of the volume or size of the equipment. The driving force may be expressed in terms of liquid concentrations or gas partial pressures. The so-called mass transfer coefficient, which is the factor inserted to convert a proportionality into an equation, has units that correspond to those used for the rate of transfer, volume of equipment and the driving force.

Data on these transfer coefficients are correlated and used for commercial design either directly or in terms of a related height equivalent to a theoretical plate (HETP) or a height of a theoretical unit (HTU). These are all treated at length in standard texts and require no elaboration here.

The selection and design of a commercial absorption operation involves consideration of: choice in conditions of solvent; throughputs of liquid and gas phases; pressure drops; and rate data on commercial liquid-gas contacting equipment.

Fundamental to all absorption operations is the requirement for reliable equilibria data, which is inherent in the selection of solvents for any specific application. Equilibria data should be obtained experimentally, if possible. However, if extensive data are available on similar systems, it may be possible to minimize the amount of experimental information required.

Consider Others

Note that in addition to evaluating carefully alternate methods for conducting an absorption operation, it is often advisable to consider the possibility of using a method of contacting other than absorption for a given problem.

These include the condensation of a solute using either cooling water or refrigeration with the solute recovered in a relatively pure condition. Where inlet solute concentrations are high, such condensation methods are often much more economical than absorption. In some cases it may be advantageous to combine condensation with a subsequent absorption or adsorption treatment to remove final traces of a solute.

The primary advantage of adsorption is that the recovery of solute in the boiling range of ordinary solvents is practically complete and independent of solute concentration in the inlet gas. Furthermore, adsorption has the additional advantage that a mixture of solvents can be recovered.

Under certain conditions, distillation under pressure may be preferable to absorption as a method for recovering solutes which are present in very high concentrations. Economic evaluations are necessary for selection among these alternate methods.

Chemical Reactions

Engineers generally think of absorption as a purely physical phenomenon, except for some special cases where chemical reaction occurs simultaneously with absorption. This is a very unfortunate and completely fallacious concept.

There are very few cases of absorption which are strictly physical in nature, such as hydrogen or oxygen in water which presumably involve no chemical effects. Essentially all absorption operations involve some form of chemical reaction or association between gas and the solvent. Many of the difficulties that have been encountered in the design of commercial equipment for a given application originated in the failure to appreciate that chemical kinetics might have been the rate-determining factor.

In many instances, it is possible by adjusting conditions, to shift from diffusional to chemical resistance as the major rate-determining factor.

An example of an important application where chemical rates control the absorption operation is the absorption of carbon dioxide by carbonate solutions or amines with subsequent regeneration.

Vaporization and Condensation

Many chemical engineering operations involve some form of vaporization or condensation in a variety of liquid-gas contacting devices. Among these operations are distillation, rectification, condensation, drying, evaporation, absorption, stripping, humidification, dehumidification, water cooling, etc. Several of these operations are discussed in more detail elsewhere in this Report.

All vaporization and condensation processes involve mass transfer between gas and liquid phases with the rates a function of such mechanisms as diffusion, bulk mixing of phases, etc. Actually, both condensation and vaporization occur simultaneously wherever liquid and vapor phases are in contact.

The over-all result of such contact is a resultant of the rates of the opposing mass transfer. Equilibrium conditions correspond to equal rates of mass transfer in the two directions. A variation in any of the conditions such as pressure, temperature or concentration, will swing the over-all result in one direction or another, thus producing an effective vaporization or condensation, absorption or stripping, humidification or dehumidification, etc.

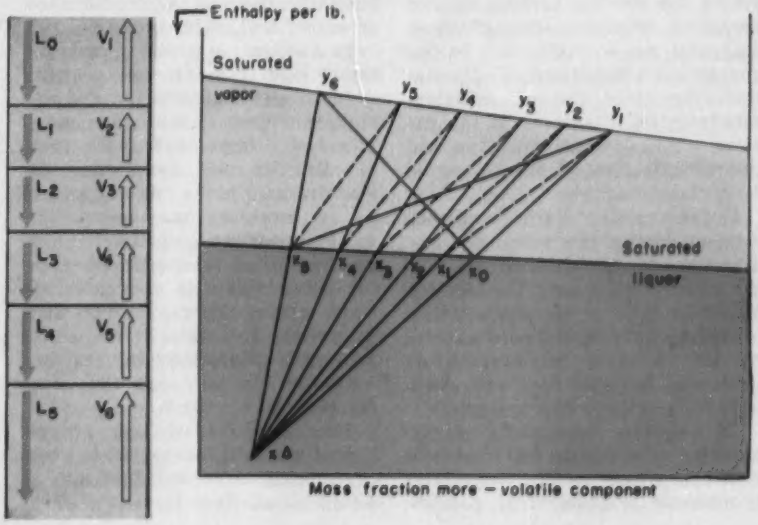
The single most important factor in any such operation is equilibrium, whether it is actually attained or not. A discussion of any liquid-gas contacting operation without full appreciation of physical chemical principles — particularly phase equilibria—would be superficial and meaningless. The distance from equilibrium in any practical commercial operation represents the driving force or activating potential which is directly related to the rate of transfer, and correspondingly, to the size of equipment required for carrying out the operation.

Molecular Energy

Molecular speeds and energies of molecules vary over a wide range. In each liquid and gas phase there are always a certain number of highly energized molecules that move at speeds far higher than the average. Such molecules, upon reaching the surface of a liquid may have sufficient energy to detach themselves from the attractive forces in the liquid phase. These molecules which assume the gaseous state are considered vaporized.

As the number of such vaporized molecules in the vapor state increases, the number of impacts of the gaseous molecules on the surface of the liquid will continually increase (assuming a limited gas

Enthalpy – Concentration Predicts Stages Required



space, of course). The frequency of these impacts represents the pressure exerted by the vapor.

When one of the gaseous molecules strikes the surface of the liquid, it enters the field of attractive forces of the aggregated liquid molecules and is retained there. This is known as condensation. When a condition of dynamic equilibrium is achieved, the pressure of the vapor is constant since the production of new vapor is just compensated for by condensation.

The pressure exerted by the vapor at a given temperature is called the vapor pressure of the liquid. At any given temperature, the magnitude of the vapor pressure is directly related to the maximum potential energies of attraction that must be overcome to produce vaporization. These energies, which are determined by intermolecular attractive forces, are dependent on both the size and nature of the molecules. The forces usually increase with increased size and complexity.

Therefore, the vapor pressure at any given temperature decreases with increasing molecular weight for similar liquids.

Enthalpy-Concentration

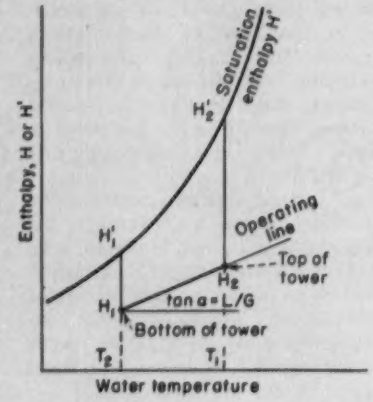
Enthalpy-concentration diagrams are convenient tools for resolving problems where heat effects accompany changes of composition. Examples of their use are found in many textbooks, particularly with regard to problems in distillation and evaporation (see p. 183).

Although they represent a simple means for solving various mixing problems, relatively few of these diagrams are available due to the sparsity of reliable data. In distillation, the chief use of enthalpy-concentration diagrams is the determination of heat quantities and the visualization of effects caused by certain changes.

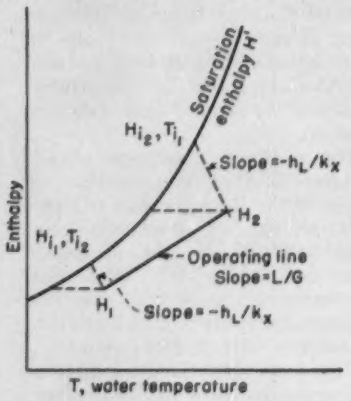
Unfortunately, many textbooks over-emphasize the value of these diagrams for the determination of the number of stages. The same is generally true of the applicability of enthalpy-concentration diagrams to the solution of evaporation problems. Reliable data are available for relatively few systems.

In selecting commercial equipment for vaporization and condensation operations, careful consideration should be given to all possible alternates regardless of whether they have been used previously for a given operation. It is important to evaluate such factors as phase phenomena, equilibria, and direct vs. indirect heating.

Find Diffusion Units...



...Correct for Liquid Film



Direct-Contact Heat Transfer

Heat transfer is an inherent and a critical factor in practically all liquid-gas contacting operations. In distillation, heat is the media by which the liquid and gaseous phases are maintained to achieve separation of constituents. Heat effects accompany most absorption and desorption operations. In many operations the rate of heat removal or addition is the limiting factor that determines the capacity of a unit.

In condensation and vaporization operations, heat transfer is the predominant factor. Heat effects are also important in air conditioning; humidification and dehumidification of gases; and water cooling.

In addition to these operations, where heat transfer may be either a minor and incidental or a major operating factor, there are many potentially important applications of direct-contact techniques for heat transfer alone and not merely as an accessory mechanism. The most important and familiar examples of direct-contact heat transfer between liquids and gases are water cooling towers. They are used to contact hot water from either process or comfort cooling systems, with air. The air cools the water for recycle.

Heat transfer surfaces are required where it is essential to avoid contamination of one fluid, gas or liquid by another. However, where a liquid and a gas are the two fluids involved, the two phases can be separated after exchange of heat, thus minimizing investment.

Direct-contact heat transfer can provide far more efficient heat exchange per unit volume of equipment and result in more uniform performance with elimination of surface-fouling problems.

The methods of calculating direct-contact heat transfer are basically the same as those used for surface exchangers, with the rate of transfer taken as proportional to a driving force and a surface area. An equality is obtained from this proportionality by the insertion of a heat transfer coefficient. Since the surface area cannot be evaluated for direct-contact exchangers, the performance is calculated on the basis of volume of equipment, with appropriate units for the heat transfer coefficient to make the equation dimensionless.

The mechanism of these operations involve both sensible and latent heat transfer. Therefore, the enthalpies of the gas streams should be used to postulate driving forces and changes in condition of the gases, rather than using humidity or temperature differences alone (see sketches above).

There is an unfortunate and surprising reluctance on the part of many to use the direct contact of water with high-temperature gases.

This can often result in using costly tubular exchangers where simple direct-contact operations could accomplish the job just as well. There is also unfounded concern about the difficulties of foaming, spouting and boiling in direct-contact units.

The advantages of direct-contacting operations over surface heat transfer—where they are applicable—represent some of the greatest potentials that can be developed at this time for any liquid-gas contacting operation. The principles developed for water-air systems are directly applicable to other gas-liquid combinations, particularly where large temperature ranges are involved.

Ejectors of various types are excellent examples of the application of direct-contact principles to provide simple and economical heat exchange between a liquid and a gas. This principle can be applied readily to condensing many organic vapors with water, followed by relatively simple separation of the liquid phases.

Many confident predictions have been made regarding the future applications of direct-contact techniques in atomic-energy, in gas turbine cycles and in the field of jet propulsion.

Gas Scrubbing

The removal of dust and mist, in the form of innumerable types of solid and liquid dispersoids, is of ever-increasing importance in industrial operations. Mechanical dispersoids may be produced by the reduction in size of larger masses of material, spraying of liquids or grinding of solids. Condensed dispersoids are the result either of gas-phase reactions or of condensations from the vapor phase.

The removal of dust and mist from gas streams is important for one or more of the following reasons: elimination of health, safety and explosion hazards; recovery of valuable products; process requirements; etc. Important operating factors to consider when handling dust and mist are: settling velocities; range of particle sizes; relative quantities of entrained particles and gases; and physical properties such as porosity, bulk density, flocculation, electrical and other characteristics.

A comprehensive discussion and bibliography of this subject is available in Perry's "Chemical Engineers' Handbook," 3rd. Ed., pp. 1,013-1,050.

Controlling Mechanisms

A great deal of fundamental work has been published on mechanisms controlling the operation of commercial dust collection equipment. These include such diverse principles as: gravitational settling; centrifugal separation; inertia and momentum; filtration; electrostatic precipitation; chemical techniques; thermal precipitation; gas scrubbing; and agglomeration by coalescence, ultrasonics and other means.

Reliable theoretical bases for calculation of equipment designs for most of these mechanisms are not available. Practically all such designs are empirical, especially in view of the tremendous variation in properties of industrial mists and dusts.

Furthermore, many types of commercial equipment involve more than one of these mechanisms. Accordingly, operations are usually classified in terms of equipment types rather than underlying mechanisms.

Dry vs. Wet Separation

Gas scrubbers where liquid-gas contacting facilitates or permits the removal of dusts and mists from gases are becoming more important. Equipment is now available to integrate scrubbing action with practically every other variety of dust and mist collection. Many of these units will permit the removal of particles on the order of 1 micron, although flocculation or condensation may be required to permit efficient recoveries.

For any gas cleaning problem careful consideration should be given to both dry and wet separation methods. If wet methods appear to be technically feasible, due consideration should be given to all of the alternate liquid-gas contacting equipment and variations which can often be developed for special applications.

Theoretical factors may provide a qualitative guide in the evaluation of the relative merits of alternate scrubbing operations for a given application but it is usually advisable and necessary to rely heavily on actual performance data on the given or comparable systems. Since few comprehensive, comparative operational data have been published, it is necessary to use the test data and engineering advice of equipment manufacturers.

When a gas stream that contains dust or mist impinges on a surface, the gas is deflected around the surface while the dust or mist particles, because of their greater inertia, tend to collect on the surface. Centrifugal force may be used to augment this effect. A factor related to direct impingement is interception. Interception refers to the collection of particles that pass close enough to the surfaces to touch the collector and be retained by it. For optimum impingement it's desirable to have scrubbing liquid particles in the range of 50-100 microns. Diffusion becomes significant for sizes up to 5 microns.

Dry impingement separators are sometimes modified where the dust tends to become tacky by providing circulating-water films that keep the surfaces clear.

A common conception of gas scrubbers is that the particles must be wetted and that designs must be provided to displace inert gas layers around the particles. There is considerable evidence that the wettability of the particles by the liquid is not necessarily required for efficient dust removal. Undoubtedly, wetting agents do prevent reentrainment of particles after impingement.

For particles in the submicron range and up to perhaps 5 microns, a major factor is the deposition of particles on liquid drops by Brownian motion. Diffusional effects are also important in removal of droplets or mists. The rate of diffusion is rapid for small particles and large concentration gradients. The density of the particle has relatively little effect on the diffusion rate. Many of the recently developed gas scrubbers, such as the venturi types, involve diffusion as a major controlling factor.

Sprays and Sonics

Agglomeration of solid particles may be accomplished by using a

liquid spray. This humidifies the gas with possible changes in the electrostatic forces on the particles. This may cause the particles to flocculate and thus permit removal of the agglomerates.

The utility of such a method is, of course, a function of the particular dust and gas conditions involved, although it is more likely to occur with high concentrations of fine dusts.

Sonic precipitation methods appear to have some potential and have been applied in the collection of sulfuric acid mist. When vapors are condensed, small droplets act as nuclei to give an increase in the effective size of particles. This method is used to coalesce mists and to remove dust particles by using a liquid spray to bring the gas through its dew point. This method does not appear too promising for relatively high concentrations of dust.

Thermal separation methods are also used to increase the size of droplets and ease removal from gas streams. As mentioned above, some scrubbers have been developed which are based on impingement processes but with the liquid flowing as a film over the surfaces rather than dispersed in the gas phase. Although there may be some additional agglomeration or condensation phenomena involved, the primary function of the liquid is to sweep clean the collecting surface and prevent reentrainment of particles into the gas phase.

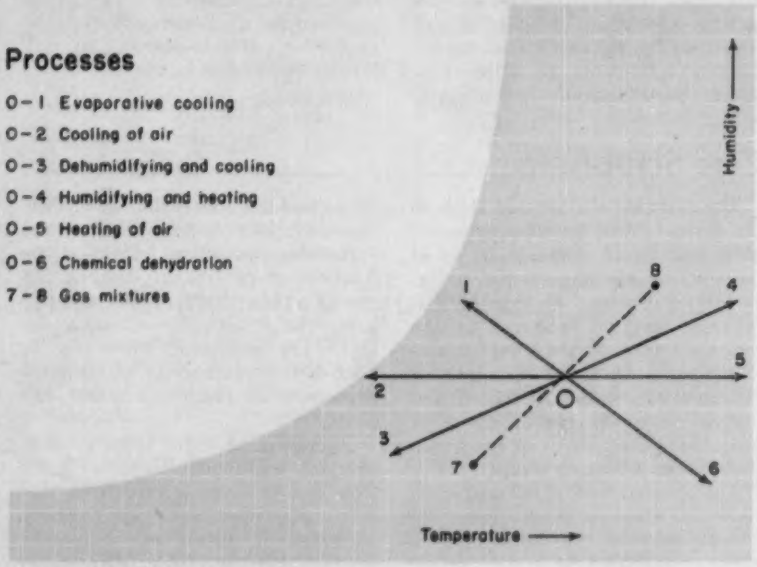
There has been some interest in the possibility that droplets of water may become electrically charged due to the rupture of water streams and the impact on surfaces. The resulting electrostatic precipitation may be a factor in the operation of many commercial gas scrubbers but the basic mechanism is not very clear.

Use of Fogs

A number of commercial scrubbers involve passing gas through the liquid phase in such a way as to divide the gas phase into very small elements. It is believed that the liquid may act merely as a receiving surface in such cases with particle displacements brought about by gravitational settling and Brownian movement within the bubble. However, the relative importance of this as opposed to impingement in commercial scrubbers would be difficult if not impossible to estimate.

Aerosol particles less than a few microns in diameter are not efficiently recovered in most commercial cyclones and scrubbers. Among the methods that have been proposed to solve this problem are the injection of water fog to promote impaction, sonic agglomeration and the use of adiabatic steam and ethylene glycol vapor to produce condensation.

These various techniques are intended to build up the size of the aerosol particles to permit their efficient removal from gas streams by standard commercial-scale separators. Many special designs are also available.



Humidification and Dehumidification

In terms of the number of installations and total investments, the most important and most widely encountered liquid-gas contacting operations are found in humidifying and dehumidifying gases and cooling liquid by direct contact of gas and liquid phases.

The bulk of these applications relate to the water-air system, although the general theory, engineering design and contacting techniques can be applied to other gas and liquid systems.

Practically any of the liquid-gas contacting methods discussed in this Report could be applied to such services. However, since such relatively large volumes of low-cost gas and liquid are involved in the air-water system, it is necessary to use equipment and techniques that involve low investment and operating costs.

For other systems, with smaller volumes of more costly materials, consideration should be given to alternate types of tray, packed, spray and other equipment such as are used in absorption and various other operations.

Simultaneous mass and heat transfer always occur in these operations. Both latent and sensible heat transfer are involved. Therefore, enthalpies are now generally used to predict driving forces and conditions in the gas phase, except for special cases such as adiabatic humidification.

At any point in an apparatus the direction of mass transfer is dependent upon the driving force in terms of humidities, or vapor concentrations, between the main gas stream and a gas layer adjacent to the liquid surface. Therefore, the mass transfer resistance is within the gas phase. Both humidification and dehumidification of a gas

stream may occur at different points in the same equipment. Evaporation and condensation phenomena involve latent heat transfer in direct proportion to the mass transfer. Sensible heat is also transferred in accordance with temperature gradients within the liquid and gas phases.

Transfer units of commercial equipment are postulated on humidity, temperature and enthalpy driving forces, although enthalpy driving forces are desirable as the basis of design wherever possible. In spite of the apparent simplicity of these operations, the basic operations are not very well understood. For instance, there is no evidence that the interfacial surface for diffusion in packed columns does not necessarily correspond to the surface for heat transfer.

Very little performance data on plant-scale equipment are available since such data are considered to be confidential by the manufacturers. Operating companies have published very little information on their installations. In most cases, completely designed units are provided by the equipment fabricator, including performance guarantees based on a great deal of accumulated plant performance data. While such procedures have advantages, they are to a large extent responsible for the lack of effective interchange of data and process technology on various liquid-gas operations and the excessively slow evolution of many basically simple types of equipment.

Commercial Processes

The chart on p. 186 is a schematic representation of various air conditioning operations shown on a standard humidity vs. temperature psychometric diagram. Commercial processes incorporate many combinations of these operations together with indirect heating, cooling vaporization and condensation.

Line *0-1* corresponds to evaporative cooling where air is contacted with a water spray, the process following the wet-bulb line. Line *0-2* represents cooling of air and line *0-5* the heating of air; in each case without altering the humidity.

Line *0-3* represents a dehumidifying and cooling operation where both sensible heat and humidity decrease. Line *0-6* can be accomplished in commercial operation by chemical dehydration such as the adsorption of water from the air by a solid material.

Line *0-4* illustrates a change where both sensible heat and humidity increase, involving both heating and humidification. Points along the line *7-8* correspond to various mixtures of gases corresponding to these terminal conditions.

Similar psychometric charts can be constructed for other liquid-vapor systems.

Humidification

In air conditioning practice humidification generally refers to processes for preparing air of a desired temperature and humidity. Humidification is, of course, incidentally involved in water-cooling operations, but here the product is water of a specified temperature.

Commercial equipment for conditioning air usually involves spraying water or steam from nozzles into an air stream in a compartment-type unit. Naturally, packed, tray, spray and other contacting techniques could be used but these usually require more space.

Fig. 1 below shows a humidification scheme where the air is preheated from point 1 to point 2 by passing over coils or banks of thin tubes, followed by adiabatic cooling from point 2 to point 3. After this, the air is reheated indirectly to point 4. Many other arrangements are used commercially.

The gas passing from point 2 to point 3 is cooled and humidified along the adiabatic-saturation curve. The enthalpy of the gas is essentially a function only of the adiabatic-saturation temperature, a constant during the operation. Thus the enthalpy of the gas stream is practically invariant. Accordingly, enthalpy driving forces cannot be used as the basis for design calculations.

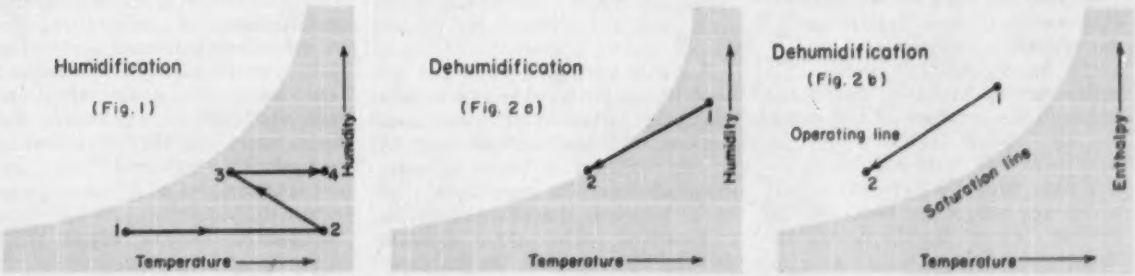
However, temperature and humidity differences can be used to calculate heat and mass transfer coefficients for correlating performance data or predicting operational characteristics.

Dehumidification

Spray washer, tray and packed columns, cooling towers and similar contacting devices can be used for dehumidification of hot humid air by bringing it into contact with a water spray. Of course, dehumidification may also be accomplished by indirect heat transfer with the condensate collecting on the surface of a heat exchange element.

Enthalpy calculation techniques are now widely used for this operation, although temperature and humidity potentials were generally used only a few years ago. Figs. 2a and 2b below show the change in air conditions in a dehumidification operation on humidity-temperature and enthalpy temperature diagrams, respectively. As in the case of humidifiers, comparatively little has been published on the

Processes to Prepare Air of a Desired Temperature and Humidity



performance of commercial equipment.

Water Cooling

Water cooling is an important operation in chemical processing and in power plants as well as in comfort air conditioning. The temperature of available cooling water is directly related to the operating pressure of distillation and evaporation equipment and to turbine or engine discharge pressure. Various designs of cooling towers, spray chambers, spray towers and spray ponds are used commercially.

Enthalpy diagrams and driving forces are now generally used for the design of water-cooling operations. Again, while a great deal of small-scale studies have been reported on various types of contacting equipment, relatively little data are available on commercial-scale apparatus.

A major problem in the design of commercial units is the maintenance of uniform air and water distribution over the entire cross-section and height of the unit. As is the case in other operations, end effects for spray towers can be misleading if they are ignored in design calculations.

As in the case of absorption and distillation, precautions must be taken to avoid channeling in packed columns.

In the operation of water-cooling systems, hot water is usually passed countercurrent to the gas. The liquid is cooled because of evaporation of some of the liquid and a loss of some sensible heat. The gas, in turn, is usually heated and humidified.

A later section of this Report will describe in greater detail the kind of equipment used industrially for these operations.

Very comprehensive and precise enthalpy-concentration data are available for the air-water system. The value and need for enthalpy design methods are illustrated by the erroneous statement—found in many handbooks and texts—that water cannot be cooled below the wet-bulb temperature of the entering air. Using humidity-temperature potentials, it is possible to obtain data from a water-cooling unit which are completely impossible to correlate except by the use of enthalpy potentials.

Vacuum, Mixing and Fluid Transport

For the major liquid-gas contacting operations, many accessory operations are required. Among the more essential—in addition to those cited previously—are the production of vacuum; mixing of liquids and gases; and fluid transport. The ejector or jet principle has proven to be extremely versatile and valuable for the design of equipment to conduct these operations.

While air, water and other gases and liquids may be used as motive fluids for jet devices, steam is used most often. In a steam-jet unit, the steam is forced through a nozzle at very high velocity into a mixing space. Here, due to the low pressure brought about by the action of the high-velocity stream, momentum is transferred to the gas or vapor that serves as a secondary fluid. The steam with the entrained gas—still at high velocity—now enters the diffuser tube where the velocity of the mixed vapors decreases with increase in pressure. The work of compression results from the conversion of kinetic energy. Thus, the ejector functions as a compressor. The discharged mixed vapors pass either to a condenser or into the next stage of a similar ejector.

Where there is condensable vapor with little, if any, inert gas the simplest way to create vacuum is to condense this vapor. Ejectors are used to remove noncondensables such as air in order to maintain the pressure differential required to assure the flow of vapor to this condenser.

Many operations that use jet siphons and eductors have been developed where water is the motive fluid and a separate ejector for the removal of condensables may or may not be required. The water jet entrains the vapors and gases and discharges the mixtures to a barometric leg or hotwell.

Mixing

Jet and venturi devices can be used to agitate liquids and to mix gases or mixtures of gases and liquids. The motive fluid may be liquid, condensable vapor or inert gas. Commercial equipment of various designs is available for such applications. The same general principles are used in the design of direct-contact jet heaters which use steam as the motive fluid to entrain, mix with, heat and pump the suction fluid.

Other heating devices involve the use of spray nozzles for atomizing liquids, tray and venturi designs for producing large quantities of hot liquid by direct-contact with steam.

Fluid Transport

The jet principle is used extensively for exhausting, evacuating, transporting, compressing, agitating and pump priming. Condensable vapors or inerts may be used as the motive fluids. The airlift is used to raise liquids by means of compressed air. A jet of compressed air is introduced into a discharge pipe at the submerged end. The ejector effect is combined with buoyancy of air-liquid slugs. Since the slugs are lighter than liquid alone, the result is to force the mixture up through the pipe. While the equipment is basically very simple, the theoretical bases are so poorly understood that all designs are necessarily empirical.

Industry still uses, to a limited extent, displacement pumps which function by forcing a liquid from one point to another by means of pressure exerted by a gas. An example of this is the classical acid egg. This is just one more example of how liquid-gas contacting can be used for fluid transport.

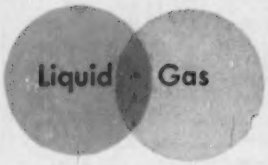
The design engineer is often faced with a choice between these two categories of equipment:

- Ejectors, venturi devices and direct-contact heat exchangers.
- Mechanical pumps, agitators and surface exchangers.

The second category does not fall within the scope of this Report.

However, the decision as to which category of equipment to choose from should be based on careful consideration of properties, capacities, conditions and costs. The ejector operations are emphasized here because, although they are generally used as auxiliaries for other operations, they represent in themselves unique and rather important examples of liquid-gas contacting techniques.

Objectivity is the responsibility of the design engineer.



Contacting

Equipment

CERTAINLY there is no single technique or equipment that is a universally optimum method for conducting all liquid-gas contacting operations. Indeed, many engineering modifications of a given contacting device must be custom-tailored for a given application or type of operation. Thus, in the design of bubble-cap absorbers for the production of nitric acid, heat transfer coils, the volume of the tower and provision for removal of entrained solid particles are characteristic of the particular system being considered.

A greater degree of standardization of many of the components of contacting devices—which are often similar and in many cases identical—would facilitate development of simplified and more economical industrial equipment. Designs for a given operation would take into account special properties and characteristics of the system involved. With more reliable plant-scale data on a relatively small number of the more efficient contacting devices, there would gradually be less reliance on familiar, well-established, but often not too efficient methods. All industries would benefit in time.

More data could be accumulated and made available on large-scale operations to permit engineers to produce more complete designs rather than to rely as heavily as they do on the information and advice of equipment fabricators. Data from equipment manufacturers are often conflicting and usually difficult to evaluate.

The competitive situation among equipment manufacturers makes it mandatory for them to look constantly for new or improved liquid-gas contacting devices, which they naturally publicize and make broad claims for. It would be trite to suggest that many of these claims are somewhat exaggerated.

The basis for comparison on which new equipment developments are hailed as possible solutions to all industrial problems are often unconsciously erroneous. Consequently, it behooves the designer to use discretion and some degree of skepticism with regard to such claims. This should not be inferred to be a reflection on equipment vendors in general. Many of them provide engineering services to industry that are comprehensive and rather valuable.

An excellent example of the above is illustrated in the case of new distillation equipment. Bubble-cap towers are certainly not the optimum method for accomplishing all liquid-gas contacting operations, nor for that matter for accomplishing all distillation operations. Nevertheless, they are still the most widely used units in distillation practice, and should continue to occupy an important rank in commercial equipment in the forseeable future.

There are very few, if any, new sieve-type and other trays, packings and other gas-liquid contacting devices that are not represented as being vastly superior to bubble-cap towers. The difficulty in most cases of comparing new equipment with existing equipment is that data or conditions selected for these comparisons are often not valid and objective.

On the other hand, it is often surprising that many of the largest equipment manufacturers have such a relatively narrow perspective regarding the applicability of their product or techniques to various new operations. In many cases, designers and operators are able to point out to the vendor possible new applications of his basic techniques or equipment.

In the discussion that follows we have arbitrarily grouped commercial contacting equipment into these major categories: tray towers, packed towers, spray units, jets, vaporizers, condensers and mechanical contactors.

This is certainly not the only possible classification and it is not necessarily complete. However, other equipment can be either inserted into one of these categories or added as additional classifications.

The basic mechanics are quite different for most of this equipment. Thus, tray towers are stagwise units with alternate mixing, retention and separation steps. Well-packed columns, spray units, jets, etc. involve continuous countercurrent flows of liquid and gas.

Tray Columns

Tray columns are among the most widely used and commercially important liquid-gas contacting devices. In distillation, bubble-cap trays are used most often. However, perforated and sieve plates of various designs are becoming more popular.

In many of the new developments, sieve- and perforated-type trays have been shown to have better efficiencies than bubble caps. In addition, allowable vapor velocities are comparable to those for bubble-cap trays. Among the disadvantages are: the dumping of liquid which can occur if vapor flow stops momentarily; relative inflexibility of columns with variations in boilup or gas rates, permitting a relatively narrow range of gas velocities.

In absorption operations, bubble-cap and other trays are operated along lines similar to those followed in distillation practice. Tray columns are still more reliable in their operating characteristics than packed or spray units for large-scale operations.

Spray-type columns have been applied in certain low-pressure

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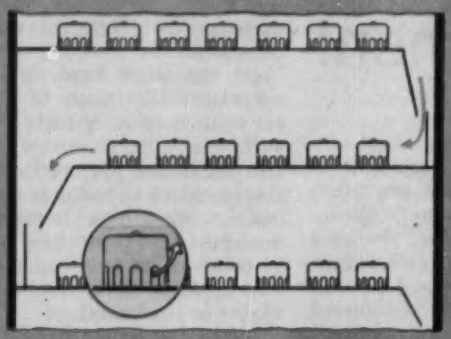
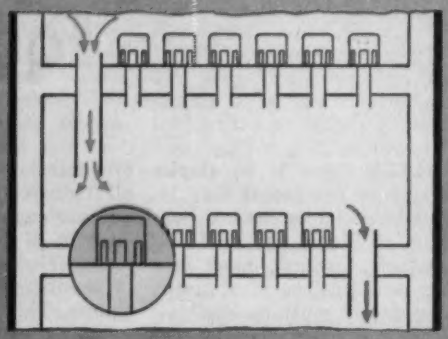
Tray Columns

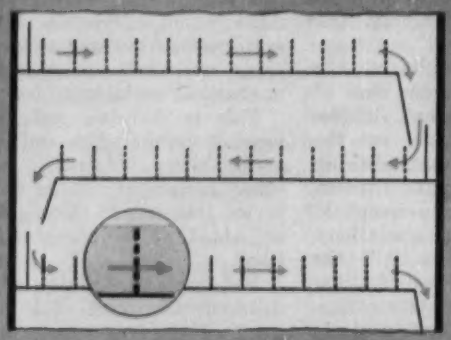
Bubble Caps



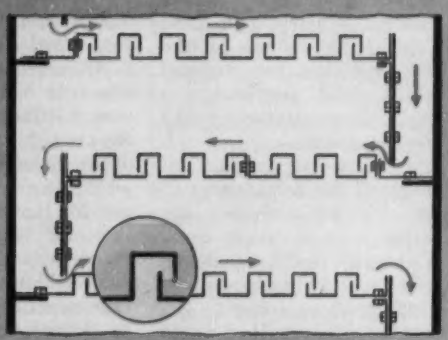
Hollow Bubble Caps



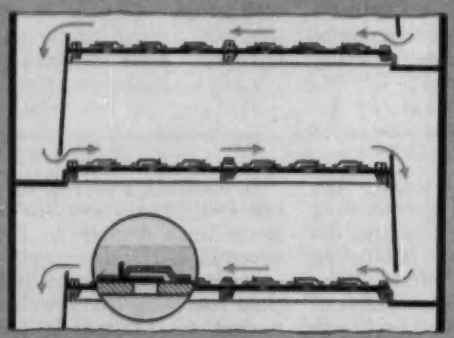
Benturi



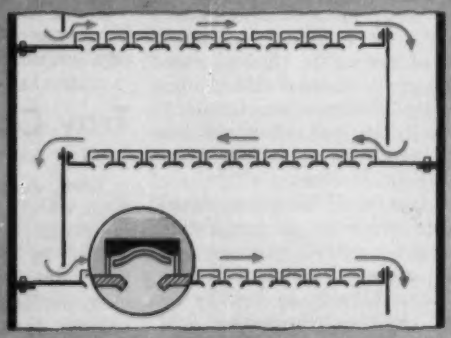
Uniflux



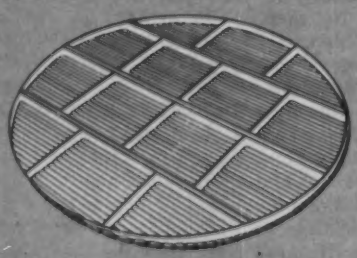
Float Valve



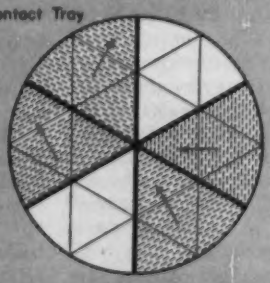
Flexitray



Turbogrid



Kittel Contact Tray



operations with the liquid being collected periodically for redistribution. Shower-type trays have been developed where liquid pours from one plate to the next through perforations. Vapor flows across the shower but does not pass through the liquid. Similarly, disk-and-doughnut trays have been designed, again with vapor passing through a liquid shower.

Excessive Duplication

It is somewhat surprising that there is so much duplication of effort in studies on a given type of tower or tray for a particular operation such as distillation. There is relatively little fundamental information on the basic mechanism of trays, partially because of the inherent complexity in—and to some extent because of the general empirical approach to—the design of such units. It has only been in recent years that a number of serious and well-considered programs have been undertaken aimed at providing a more realistic basis for selecting and designing trays for a given operation.

We hope that this objective approach to selection of an optimum unit for a desired operation from among all the available alternate methods, will be extended to include a comprehensive evaluation of all liquid-gas contacting techniques.

In one of the comprehensive research programs now under way, an effort is being made to study the effect of system properties and bubble-cap tray design on efficiency. In another program, recently initiated, the goal is to determine and compare the efficiency and capacity of all types of fractionating devices. Both programs appear to be worthwhile. But results from them should be used with discretion.

It is not sound to generalize, even for distillation alone, from tests conducted on one system in a particular pilot unit. It is not safe to extrapolate simulated data to commercial operations. The system on a large-scale may have tremendously different properties than those scaled-up from smaller test size units.

Sieve-plate columns are not used very extensively for absorption operations. However, the plate efficiencies for absorption are somewhat comparable to those found in distillation. They may possibly be somewhat lower because of greater resistance to mass transfer with the nonboiling liquids used in absorption operations.

Tray Dimensions

Bubble-cap towers usually—but not always—have equal tray spacing. The trays are spaced from 6-in. to 3-ft. apart, depending on the tendency of the liquid to foam and be entrained from one tray to the next. Larger columns are often designed with a spacing of 2 ft. or more to facilitate placing manholes at each plate for cleanout.

Bubble-cap towers have been built in diameters of over 30 ft. Even for such large diameter columns it is possible to design for uniform and intimate contact of vapor and liquid over a wide range of flow rates of both phases. Channeling of the two phases can be minimized or avoided by appropriate tray layouts and baffle arrangements. It is suggested that when one studies the advantages advertised for new and superior tray-contacting devices, one should consider carefully the validity and justification of the comparisons.

Generally the comparisons are made with bubble-cap units to prove the efficiencies of the new equipment. However, in many cases even the equilibria data used for the comparisons are not identical. Furthermore, these comparisons are often made with bubble-cap columns that have been designed on a far-from-optimum basis. In addition, it is somewhat difficult to make these comparisons in view of the uncertain differences in efficiencies, pressure drops, loads, etc.

The situation becomes infinitely more complicated if chemical kinetics are involved, as they may be in some distillation operations.

As shown on p. 190, relatively complex cascade tray towers have been designed and built which involve horizontal flow of liquid across each tray. The vapor passages have a venturi-type cross section which offers a minimum pressure drop. This feature is particularly important in vacuum distillations. Tray spacings as low as 7 in. have been fabricated. Installation and cleaning are reported to be fairly simple.

The Competitors

Although the simple sieve tray has been used for many years in distillation and absorption columns, it has never been accepted too widely. It has a number of inherent disadvantages: narrow operating range; change in hole sizes with corrosion and fouling; weeping; and close tolerances on plate leveling. Advantages are: low cost; high capacity; high efficiency and resistance to fouling.

Designs of sieve-plate columns, column diameter, number of trays; tray spacing and downcomers are patterned after procedures used for bubble-cap towers.

Many of the new developments described below are variations of and improvements on the simple sieve tray. They are generally aimed at eliminating some of the disadvantages such as narrow operating range.

The Uniflux tray retains a number of elements of the bubble cap. Several lazy-S shapes are attached to the tray-support ring. The vapor flow is in a direction parallel to the liquid and serves to boost the flow of liquid across the tray. This compensates for hydraulic gradient. The functional vapor cap is also a structural member.

The tray is relatively light and simple to fabricate. Tower diameters should be comparable to bubble-cap towers. Performance is reported to be at least as efficient as well-designed bubble caps, with perhaps half the cost.

The float-valve tray involves a floating pivotal valve which is heavier on one edge than on the other. It is retained on the tray in a manner that limits vertical or horizontal movement. The light edge is raised at lower vapor velocities and the heavier edge is pushed upward at higher velocities. Absorption and distillation equipment incorporating these trays have operated successfully.

The Flexitray is also a valve-type unit. This tray has floating caps that are moved by the flow of vapor. The vapor opening is proportional to the vapor flow up to perhaps 60% of maximum vapor flow. Above this, all caps are open. This unit combines a capacity that compares to well-designed sieve trays with a broad operating range comparable to that of bubble-cap units. Capacities somewhat higher than

that of bubble-cap trays have been reported with a moderate pressure drop and higher tray efficiencies. Costs have been estimated at about two-thirds of comparable bubble-cap towers.

The Turbogrid trays consist of a flat grid of parallel slats which serve as passages for both liquid and vapor through the trays. Liquid is retained on the tray by the rising vapor but open areas are sized so that liquid passes downward through the same openings. The flow of liquid and vapor actually occurs as a cycling or intermittent jet action. Required liquid level on the tray is maintained by a dynamic balance of fluid flows. In larger units, downcomers are distributed and in some cases periodic redistribution of liquid and vapor is advantageous.

Mechanical details that can be varied for particular process requirements include slot width, bar and tray spacing and open slot areas. Although practically all of the effort on these trays has been directed at the distillation operations, there has been some progress in their application to: deentrainment sections above vacuum flashers and steam boilers; stripping, absorption and some indirect heat transfer uses.

Turbogrid trays can be designed from bar stock, rods or slot plates from a wide variety of materials of construction. The economic advantages, high capacity and good efficiency are considerably offset by lack of flexibility compared to bubble-cap trays.

A recycling tray is a perforated plate with recycling baffles attached to the tray floor. Another recently-announced perforated tray involves concurrent contact of gas and liquid through perforated trays. Over-all countercurrent movement of gas and liquid is provided by gas upcomers and liquid downcomers.

The figure on p. 190 also shows the Kittel contact plate which has been used for about ten years in Europe and was introduced recently into this country. It is designed to direct the flow of gas or vapor horizontally across the plate surface. Liquid is mixed intimately with and carried along by the gas. There are no downcomers, liquid descending from plate to plate through perforations.

These units are reported to be adaptable to distillation, gas scrubbing, absorption and various cooling operations. Rapid startup and high throughput rates are claimed. Horizontal flow is obtained by having ascending vapors pass vertically through inclined rhombical plate openings.

Many unique tray designs have been developed for special applications. The hollow bubble-cap tray was designed to handle heat sensitive materials such as fatty acids. Maximum temperatures and total exposure times are reduced considerably over other distillation methods, thus reducing the amount of fatty acids polymerized to tars or cracked to hydrocarbons.

Dowtherm vapor passes underneath each tray as a heating medium. Somewhat similar designs have been suggested for other kinds of tray columns, such as the Turbogrid, with heat transfer fluids passing through hollow rods.

Tray Scrubbers

A number of tray towers have been developed in recent years for the wet scrubbing of dusts and fumes from gases. They have proven to be very efficient and versatile units.

One widely-used commerical tower is an adaptation of a sieve-plate tower. Gas enters tangentially at the bottom of the tower, loses the coarse particles by cyclone action and passes through water sprays which may also serve to quench hot gases. The sprays may be arranged in various ways and the gas may be brought in directly rather than tangentially. The gas then flows upward through one or more sieve plates. Baffles are arranged over each opening in the sieve plate to divide the gas into small streams. The gas then passes through an entrainment separator before leaving the unit.

The water introduced on the plates and through the nozzles may serve not only to remove suspended impurities and cool the gas, but also to scrub out soluble vapors and provide quenching, humidification or dehumidification of the gas.

Pressure drops are relatively low and capacity high. A unit 6-ft. high and 4-ft. in dia. has been reported as being able to handle the same scrubbing duty as a packed tower 8-ft. in dia. and 130-ft. high. The arrangement of baffles over the sieve plates permits a wide range of allowable superficial vapor velocities. This particular unit appears to have a valuable potential for distillation, absorption, humidification, gas cooling and other liquid-gas contacting operations.

Units are in commerical operation, units that were originally designed for dust scrubbing. But now they are used primarily for an extremely efficient absorption operation. This is an excellent example of what the interchange of information for the various liquid-gas contacting operations can accomplish when the approach is objective.

Bubble-cap scrubbers have also been developed and are available commercially. These are quite similar in many ways to sieve-plate units except that bubble caps of the type used in absorption and distillation columns are used rather than sieve plates. As in the case above, the gas enters at the bottom and passes through a spray chamber to remove larger dust particles. The solids are removed from the bottom of the unit in various ways depending on the concentration and nature of the slurry or sludge. One or more trays may be used.

Another type of wet scrubber which may be considered a combination of jet and tray design is the disintegrator design. Gas is led to a high-pressure water eductor and the mixture of gas and water impinges on a plate. This causes discharge from the plate at a high velocity through serrations at the edge of the plate. A number of these elements may be operated in series for larger capacities.

Packed Columns

One of the most widely used kinds of liquid-gas contacting equipment is the packed tower. The term, packed tower, is used here in its broadest sense to include not only units commonly used for gas absorption, but also for equipment such as cooling towers used in air conditioning and water cooling.

The packed tower as used in absorption and distillation operations consists essentially of a vertical shell placed on an adequate foundation and filled with a packing ma-

terial. In spite of the tremendous amount of data that have been published on packed towers, particularly for gas absorption, design methods are still much more an art than an applied science, with major reliance placed on pilot testing on as large a scale as possible.

There is probably less standardization in the field of packed towers than in any other grouping of chemical engineering equipment. There is little doubt that much of the data published is almost useless for both practical design and for elucidating basic mechanisms. For this reason strong suggestions have been made that the extensive empirical studies on packed columns, particularly in universities, be curtailed until a more valid and realistic approach is developed.

Packing Materials

Among the earliest packings were lump materials such as broken rock and coke and these are still used to a limited extent. Most of the commercial packings are now manufactured, are usually hollow and have dimensions ranging from ½ in. to 6 in.

Among the basic requirements for ideal packings are: low weight per unit volume; low cost per cu. ft.; large free cross-section; large surface per unit volume; large free volume; low liquid holdup; and high absorption capacity as indicated by high allowable gas and liquor rates under operating conditions. Obviously, it is also desirable to have packing that has a reasonable stability under the existing corrosion, thermal and mechanical conditions.

The figure on p. 194 illustrates some of the many types of commercial packings. Commercial packings can range all the way from the broken rock that is still used for sulfuric acid manufacture to new and improved woven wire mesh designs.

Coke is still used as a tower packing to a very limited extent in small operations. Other commonly used packings are Raschig rings, Berl saddles, Lessing rings, spiral rings, grid tile, cross-partition rings, Intalox saddles, Pall rings, rectangular bricks and stoneware balls.

A large number of new packings have been suggested or developed in recent years, including: Stedman, Panapak, Yorkmesh, Cannon, McMahon, Heli-Grid and Heli-Pak.

Relative Merits

In view of the extensive use of both packed and plate towers for distillation and absorption, considerable attention has been directed at comparing the relative merits of these alternate liquid-gas contacting techniques.

Naturally, many factors must be considered for each desired application that is completely unique and characteristic of a particular system. Therefore, in a general discussion of this sort, as well as because of the limited space available, we can discuss the pertinent factors only qualitatively. The relative advantages and disadvantages of plate and packed towers include the following:

- Packed towers are usually less expensive and simpler when excessively corrosive materials such as acids must be handled.
- Plate towers are preferable where interstage cooling is required for the removal of large heats of solution or reaction. Cooling coils may be installed directly on the plates.
- Packed towers are usually preferred for liquids that tend to foam.
- Liquid holdup is usually less in packed towers.
- At small liquid flow rates, plate towers can be designed more reliably because of the distribution problem in packed towers.
- In general, plate columns are more advantageous for operations that require a large number of stages. There is less vapor and liquid channeling. The problem of bypassing by liquid and gas phases can be very critical in packed columns if proper provision is not made for maintaining the distribution of the phases over the cross section of the column.
- For vacuum operation, packed towers may give lower pressure drops than plate towers. This is particularly true at low rates of reflux.
- For operations that involve liquids depositing or entraining small amounts of solids, plate towers are preferred since they are more accessible for cleaning.
- With regard to column weight, this depends on the type and size of packing as well as the holdup in a packed tower. Generally, the total weight of a plate tower for comparable duty is less.
- For operations at temperatures greatly different from normal atmospheric temperature, where periodic interruptions are expected, plate towers are more suited to absorption and distillation operations since dimensional changes in equipment may crush the packing.
- Packed towers are seldom found in excess of 4-ft. in dia., particularly in distillation service. Plate columns, on the other hand, are usually not less than 18-in. to 24-in. in dia. except for experimental purposes.
- One of the most important factors is the relative degree of certainty with which one can design a plate tower with available information. Packed towers are necessarily overdesigned because of the sparsity of reliable design information and uncertainty of operation.

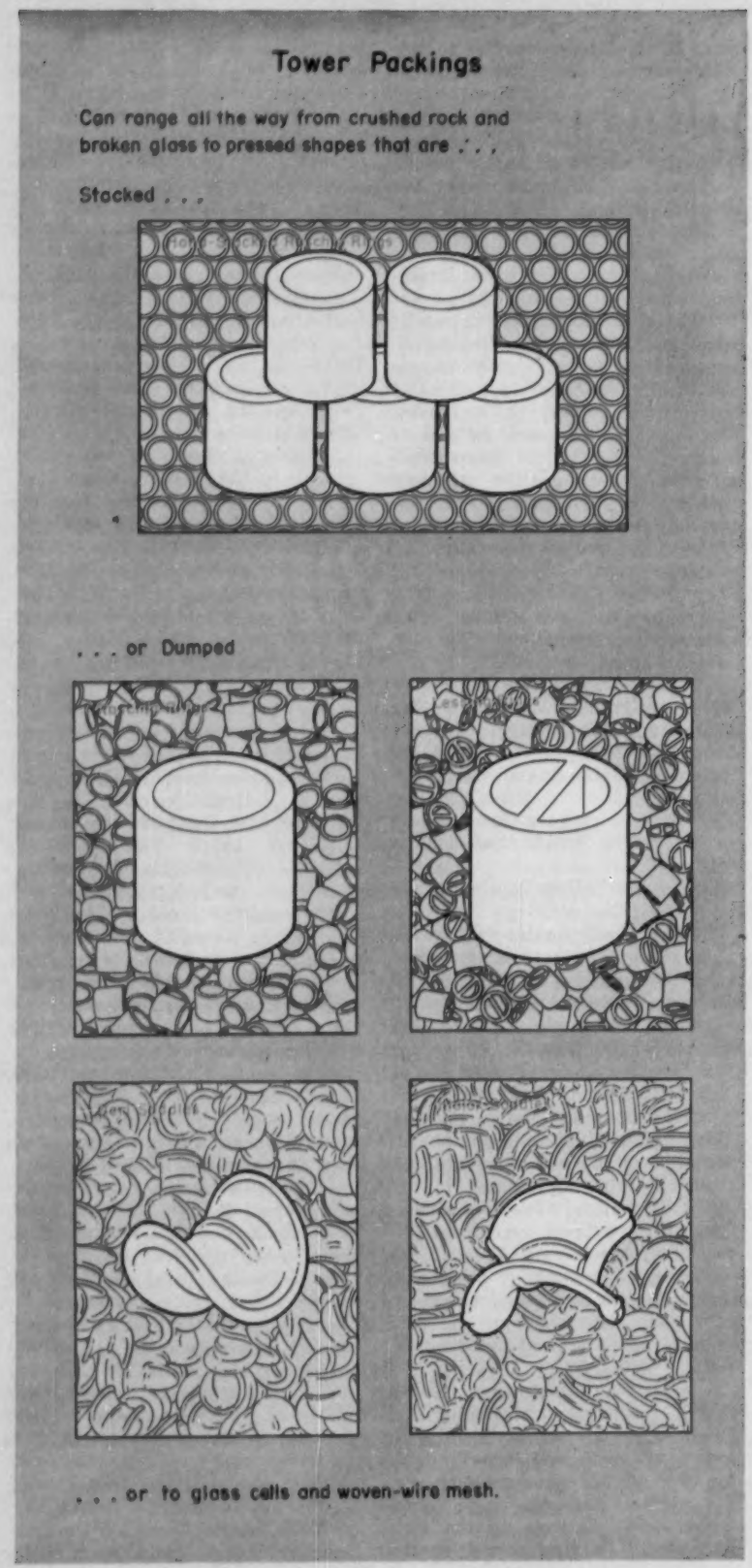
Tower Characteristics

Optimum operation of packed towers is obtained when the liquid flows over the packing at as uniform a rate as possible. In absorption work this generally occurs somewhat below the "loading" velocity with the liquids flowing freely over the packing.

The so-called *loading* velocity is specified in terms of variations in pressure drop and the gas velocity. Below the loading velocity the pressure drop varies approximately as the 1.8 power of the gas velocity. The loading velocity is defined as that point at which the power relation increases from 1.8 to somewhat above 2.0. This is by no means a fixed phenomenon, since it has been observed and studied primarily in small-scale laboratory work.

However, it has been observed even in large-scale studies that above a certain velocity, possibly such a loading point as that described above, the liquid ceases to flow freely over the packing and increased pressure drop is accompanied by increased holdup of liquid. Large pockets tend to form within the packing and considerable bypassing of liquid and gas phases generally occurs.

When the pressure drop in the column approaches the hydrostatic head of the liquid filling the column, entrained liquid appears in


Tower Packings
Can range all the way from crushed rock and broken glass to pressed shapes that are . . .
Stacked . . .
. . . or Dumped
. . . or to glass cells and woven-wire mesh.

increasing amounts in the overhead gas stream. This condition corresponds to the "flooding" velocity. Loading and flooding velocities are limiting conditions for absorption as well as for distillation.

What Is the Mechanism?

Qualitatively, a great deal is known about tower variables such as gas and liquid rates and solute concentrations; dimensions of the tower and packing; and distribution of gas and liquid. However, the actual mechanism is not well understood and designs are more empirical than for practically any other type of liquid-gas contacting equipment.

One thing is very certain from considerations of mass and diffusional transfer: the rate of mass transfer is a direct function of the actual interfacial area between liquid and gaseous phases. One of the biggest gaps between fundamental and applied studies of operations conducted in packed towers is the determination of this actual interfacial area.

For practical design purposes there is no way of predicting absolute values of capacity or transfer coefficients, except through experimental, pilot-plant and plant-scale tests that simulate as closely as possible actual plant conditions. Interfacial area is a complex function of such variables as: liquid rate; type and arrangement of packing; liquid and gas distributions; height and diameter of tower; and liquid and gas rates. Major variations occur even for a given system and equipment through the column and with time.

One of the major difficulties in the design of packed columns has been the unfortunate and erroneous custom of using over-all values of concentrations to evaluate the characteristics of a given tower or to design a new unit. As in practically all other instances of multistage interphase operations, it cannot be safely assumed that the height of a theoretical unit is constant from top to bottom of a tower.

It has been observed that in packed columns, distribution is better in a dumped rather than in a stacked bed. Increased liquid rates result in more uniform distribution, particularly for towers with high ratios of tower-to-packing diameter. The fraction of wetted

area of a packing decreases with increased packing size, possibly because of increased channeling. It has become standard practice to consider as a minimum tower-to-packing diameter ratios of 8 to 1.

The Problem of Distribution

Whether one considers absorption, distillation, stripping, gas scrubbing, water cooling or air conditioning, the problem of internal liquid distribution is one of the most critical and least understood. It is for this reason that we must rely primarily on commercial experience for mechanical details and auxiliaries for packed tower designs.

It is interesting to note that many of the schemes suggested for insuring appropriate distribution of liquid through a tower involve such a large number of redistribution points that, in effect, we are dealing with a tower that resembles a combination of plate and packed characteristics.

Water Cooling Towers

Among the most important and representing possibly the most extensive applications of liquid-gas contacting operations are humidification, dehumidification and water cooling. The use of cooling towers, spray dryers, spray towers, spray ponds and air conditioning spray chambers has grown enormously over the past several decades, largely due to more exacting industrial demands.

In chemical plants, the temperature of the available cooling water establishes operating pressures on condensers for distillation and evaporation processes and accordingly on the equipment that precedes these. Thus, the cooling water is of extreme importance in the planning and economics of design for modern chemical and power plants. Most of the cooling towers now being built involve some form of packed tower.

The term, water-cooling tower, commonly designates all devices used for evaporatively cooling water by contact with air. The older schemes for cooling water, spray pond and natural-draft chimney towers, have been almost entirely superseded by atmospheric and mechanical-draft units. While both sensible and latent heat transfer are involved in water cooling, most of the cooling is due to latent heat from the evaporation of water.

The term, deck-filled tower, is used to designate water-cooling equipment that contains baffles to increase water breakup and to provide additional wetted surface.

In atmospheric towers water is distributed at the top of the tower, flows downward and is broken up and redistributed by slats or decks that fill the tower. Actual cost is about the same as that for a mechanical-draft tower. Drift eliminators on the sides are designed to remove entrained water from the discharging air stream.

Natural-draft towers operate similarly to a furnace chimney, with natural flow of cold air in at the bottom and exit of less dense, warm air at the top. Although the atmospheric units are still being installed there is very little interest in the natural-draft scheme in the U. S.

Mechanical-draft towers include the forced draft and the induced draft. Induced-draft units involve sucking the air into the tower by a fan at the top through louvers at the bottom. Forced-draft designs involve forcing the air in at the bottom by a fan and discharging through the top. The major disadvantage of the forced-draft tower is that hot air leaves the top of the tower at a relatively low velocity and tends to recirculate to the fan inlet. This reduces over-all efficiency. Induced-draft towers consist of one or more individual adjacent cells, each with its own air circulation fan. Wood fill is normally used to provide wetted cooling surfaces and pressure and water breakup.

The crossflow design, generally referred to as Double-Flow, uses multiple fans centered along the top with each fan drawing air through two cells. Air movement is horizontal with water falling in a cascade of small drops through the air stream and across the wood-filled slats. This design provides a longer air travel than with the conventional counterflow methods.

Certainly, for purposes of both heat and mass transfer involved in cooling-tower operation, it is important to provide maximum interfacial area between the water and gas phases and to minimize the entrainment of the liquid phase in the air stream. Improved efficiencies are obtained by increasing the amount and efficiency of the packing or fill. As the tower height is increased, contact time of air and water also increases with a corresponding increase of pumping power, but with little effect on requirements for fan power. An increase of tower area and constant fan power results in an increase in air quantity and interfacial contact time. Air quantities may be increased at the expense of proportionate increase of fan power, with a reduction of interfacial contact time but with an improvement of over-all driving force.

Although engineers may calculate the theoretical number of units required for a given water-cooling duty by using the appropriate enthalpy calculation methods, it is not possible to select—with any degree of confidence—the specific type and size of a unit from available literature. Decisions on equipment must be based on mutual agreements with manufacturers who in turn rely heavily on actual performance data for comparable duties. Individual preferences and familiarity of the designer with specific types of equipment are, as in the design of other liquid-gas contacting operations, often the determining factor in selection.

It should be noted that huge increases in industrial water usage have forced manufacturers of water-cooling equipment to develop much more efficient and economic equipment over the past several decades. In some areas where water is in very short supply, expensive or polluted, water-cooling towers have had to compete with newly developed air-cooled heat exchangers. Generally, the cooling tower is less expensive, except for special cases where the temperature of the fluid to be cooled is high.

Packed Scrubbers

Packed towers have been used to a limited extent as wet scrubbers for removing solids from gas streams. In general, the types of packing used in most cases were rings, tile, grids and slats arranged to minimize dust buildup. Dust buildup is the chief limitation of this type of unit. The primary function of the packing is to serve as an impingement surface with the liquid keeping the dust washed off.

Spray Units

The simplest spray absorption tower consists of an empty chamber into which liquid sprays at the top and gases enter at the bottom. Such equipment has the advantages of very little pressure drop through the spray chamber and simple inexpensive construction. Because of the mixing of the gas within the spray chamber, entrainment of the gas by the sprays and entrainment of fine droplets within the tower, spray absorption units are not applicable for true countercurrent action nor where a large number of transfer units are required to obtain essentially complete absorption.

The category of spray-type equipment as used in this Report includes operations for both the breaking up of a liquid into drops and the dispersion of gas as bubbles in a liquid. In the first case the gas is a continuous phase and the liquid is the dispersed phase. In the case of gas dispersion, gas is dispersed in a continuous liquid phase. There are, of course, some instances where it is difficult to conceive of either phase as being truly continuous. Therefore, it is not always possible to establish a clear demarcation between spray-type and jet-type equipment.

Many suggestions have been proposed for the use of spray towers for gas absorption, since dispersion or atomization of the absorbing liquid provides a large interfacial surface. However, no serious effort has been exerted to use simple spray methods, because of the widespread acceptance of absorption towers. Failure to appreciate many of the pertinent factors such as size of spray droplets, interfacial velocity of droplets, number of droplets per unit volume of scrubber and mechanism of mass transfer, have resulted in almost uniformly poor results when spray methods were used for absorption operations.

Periodically, there have been indications of interest in the more extensive use of spray units for absorption and other operations. Much of this interest is engendered by the observation that many commercial gas scrubbers for the removal of solids and fumes from gas streams can be adapted for absorption and other operations. In many instances, it is possible to accomplish both dust removal and absorption simultaneously.

Packed towers are generally not well suited for absorption operations where the gas stream contains considerable amounts of solids that tend to deposit in the packing. It is interesting to note that such varied equipment as spray, bubble-cap, sieve-plate and centrifugal units have been designed for removing solids from gas streams.

An example of the adaptation of gas scrubbers is the use of cyclone gas scrubbers for the absorption of sulfur dioxide from dilute gases. It is not surprising that this application should be found satisfactory since the same high velocities of small droplets resulting from centrifugal action of the gases is also conducive to gas absorption. Such a unit includes the use of a vertical cylindrical shell with tangential gas inlet at the bottom and a central gas outlet at the top. Scrubbing water, after leaving the washer, passes into a settling cone from which the underflow carries the dust collected by the spray.

Sprays Don't Flood

Unlike packed towers, there is no definite maximum gas velocity corresponding to flooding in spray equipment. The amount of entrained spray removed with the exit gas increases gradually with the gas flow rate. While spray chambers involve very low pressure drop and simple construction, there are a number of important disadvantages which discourage their use for absorption applications.

Due to entrainment of the gas by sprays and bulk mixing of fine spray droplets through the tower, true countercurrent movement of the liquid and gas phases is not possible within the chamber. Thus, spray techniques may approach packed towers in efficiency but they are limited to applications that require only a few transfer units.

There has been a limited amount of interest shown periodically regarding the possibility of applying the spray technique to commercial absorption and distillation operations, particularly where solids which tend to corrode or clog packed or tray columns were entrained by the gas or liquid streams. Most of the studies reported involved small apparatus. Much of the data, although interesting, have been limited to studies of rates of mass transfer in laboratory columns and extensive work on single droplets. Practically none of these data are of any use for the design of spray chambers unless the sizes, shapes and number of drops found in such chambers at any instant can be determined.

Reliable quantitative evaluations of the relative costs of spray, tray, packed and other columns are not possible because of the lack of data from large-scale spray absorption equipment. Naturally, there is available a tremendous amount of information on air conditioning, humidification and dehumidification by spray methods which may be compared with available information on tray and packed towers.

In an attempt to circumvent the major limitation of countercurrent action in spray units, attempts have been made to develop absorption and distillation equipment where the liquid is collected at intervals of several feet of tower height and resprayed. This has been proposed for vacuum distillation, in particular. By circulating liquid through each section, much higher liquid rates can be obtained in such a multiple-spray design.

The number of transfer units in a spray column is roughly proportional to the liquid rate, although short columns are more effective per unit volume, both because the spray is more effective with the nozzle and because it tends to strike the wall in a taller unit.

Nozzle Designs

Since spray nozzles and devices are so critical in spray-type equipment, the wide range of available designs are described briefly below. Where any degree of countercurrent operation is attempted, the spray drops must be large enough to permit downward flow against the gas stream, yet small enough to provide a large liquid surface area.

Nevertheless, spray eliminators are still needed to prevent nuisance from the entrainment that may occur even at low velocities. Much higher velocities can be used in

spray towers of the wet cyclone type where the liquid enters tangentially at the bottom and spirals upward. Liquid is sprayed from nozzles fastened to a vertical manifold pipe at the axis. Contact between liquid and vapor corresponds to crossflow conditions and the equivalent of only one theoretical plate is possible. Similarly, progress has been made in the development of equipment that combines the elements of spray and tray techniques.

To provide a large interfacial area for liquid-gas contacting in operations such as absorption, either the gas or liquid phase may be dispersed. Both of these are essentially spray-type devices.

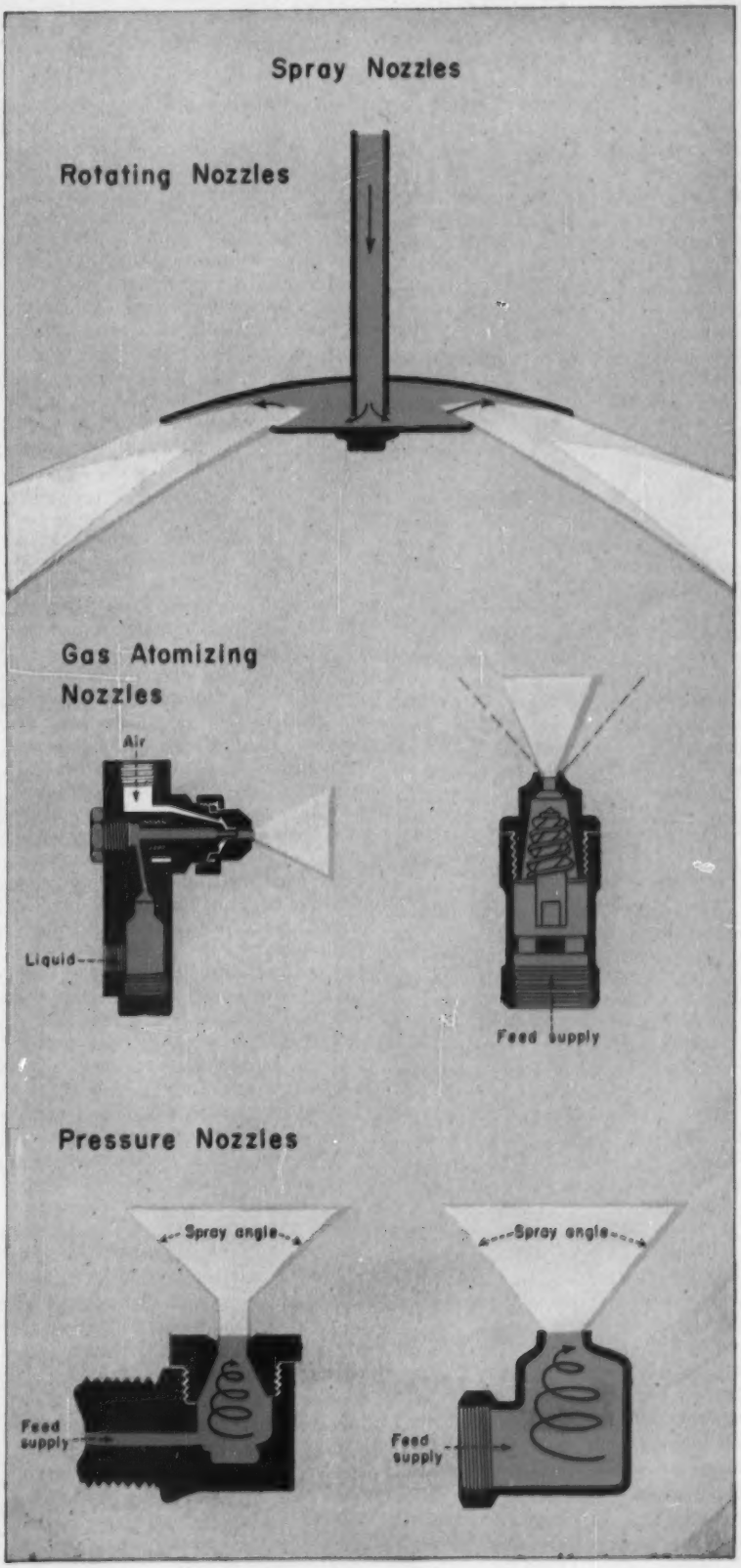
The uses of jets and venturi atomizers are closely related to spray-type equipment. Therefore, it is not surprising that many of the operations such as absorption, scrubbing of dusts and fumes from gases, heat transfer, etc., have been studied extensively in recent years with regard to the possible application of both spray- and jet-type equipment. In applying the venturi atomizer to gas absorption, most of the absorption must be achieved in the atomization zone or there is no advantage in using the venturi atomizer. The section of an atomization or jet nozzle, up to perhaps 1 in. from the point of injection, provides maximum mass and heat transfer but involves a very short contact time.

The region of such a jet device beyond the immediate tip of the nozzle can be considered as resembling a spray chamber. Where longer contact times are required, spray units would be more advantageous than venturi atomizers. Conversely, the shorter contact time in the venturi atomizer may be used advantageously where it is desired to quench a specific reaction after a given time.

A tremendous variety of commercial spray nozzles are available for practically any desired application. Some of the more important types are illustrated at the right. Spray nozzles can be grouped into three major categories:

- Rotating nozzles.
- Gas-atomizing nozzles.
- Pressure nozzles.

Rotating nozzles consist essentially of a cup or disk directly connected to an electric motor with fluid to be sprayed fed under low



pressure to the center of the rotating element. The fluid is broken up into drops by centrifugal force. Many special designs are available ranging from relatively simple to very large and expensive varieties. They have been applied to spraying paints, oil, viscous liquids, slurries and are found in some air moisteners and air washers. Rotating nozzles are widely used in commercial spray dryers.

Gas atomizers are quite similar to jets which are discussed in a later section. In these units the liquid is broken up by impingement with a high-velocity gas stream. They are used for spray painting application of insecticides, oil burners, metal decorating and spray drying.

Pressure nozzles are more simple than the two types described above and are the most widely used commercial nozzles. The units include hollow-cone, solid-cone, fan, impact and fog nozzles. They can be conveniently and inexpensively fabricated from practically any material of construction. They are small, relatively simple, inexpensive and usually consume less power than other types. Applications of pressure nozzles include practically all conceivable liquid-gas contacting operations.

Gas Dispersion

The dispersion of a gas into a liquid may be designed for: improved contacting of liquid and gas phases, agitation of the liquid phase and production of foam.

Gas may be dispersed into a liquid either by introducing directly bubbles of desired size or by disintegrating massive streams or bubbles of gas. Bubbles of desired size are introduced by such diverse methods as spraying (simple bubblers and porous dispersers), generation of gas from dissolved or finely divided materials and precipitation from a supersaturated solution. Simple spargers are widely used, particularly for agitating large tanks.

Porous plates, tubes, disks and other forms consisting of glass, carbon, ceramics and metals are widely used for chemical reactions and absorption operations. They have also been applied in certain types of flotation cells and are used extensively in sewage aeration tanks to promote gas absorption.

Drying Techniques

Although not quite exact, the basic differences among spray units designed for evaporation, water cooling, humidification, etc. and for drying are that the drying processes involve the removal of smaller quantities of liquid by vaporization than in these other operations. This should not prevent careful consideration of the relative merits and techniques used for these various operations. Attempts to classify the suitability of alternate drying techniques to various materials on the basis of whether such materials can be pumped, stirred or neither, do not provide a solution to the innumerable borderline cases that arise.

Therefore, it is possible to provide a pumpable feed in many instances suitable for spray drying by adjusting conditions or adding liquid. Most commercial drying equipment requires some type of control or adjustment of feed characteristics.

Many of the commercial techniques are variations of spray-type equipment. Gas scrubbers are, of course, also efficient gas coolers and the use of scrubbers is limited to operations where the gases may be cooled and it's possible to collect the dust as a slurry. Many variations of simple spray designs have been used, with both square and circular towers. The liquid, usually water, feeds near the top through a number of nozzles. Gas enters at the bottom, travels countercurrent to the spray and leaves near the top.

Instead of a single tall tower, shorter towers may be used with gas passing through them in series. The spray tower provides practically no resistance to gas flow, is simple, relatively inexpensive and unlike some of the other designs for wet scrubbing of gases it is nonclogging. The major disadvantage is that in a simple spray tower, with only one set of nozzles, the scrubbing action is by no means as effective as inertial, cyclone, mechanical and other more expensive units in the recovery of particles that are 5 microns and smaller.

Multistage Washers

So-called multizone collectors and washers have been developed, designed to retain the basic simplicity of spray operation and yet improve the efficiency. The gas to be washed enters a wet cyclone collector forming the base of the tower, where the larger dust particles deposit. Dust particles are removed by contact with water droplets produced with the aid of special impingement plates. The unit is a cylindrical tower with a conical bottom and can be fabricated from various materials.

Wash liquid is generally water but may be any liquid. A number of impingement stages, consisting of conical disks from which curved vanes are suspended, give the rising gas a vortex motion. Water fed at the top impingement stage runs over the edge as a circular curtain with the gas subdividing the water or other liquid into droplets. An entrainment separator is installed above the impingement plates.

A large variety of spray-compartment scrubbers are also used. They consist of a hooded entrance and a liquid-gas contacting compartment, equipped with baffles and rotor sprays.

From the brief discussion above, it is obvious that there is quite some similarity among the various liquid-gas contacting devices.

Jets

In the past the use of jet equipment has been primarily associated with the production of vacuum, direct-contact condensation and the movement, pumping and lifting of fluids. Actually, many new uses have been developed, uses that include many important liquid-gas contacting operations. Among these are: absorption of gases in liquids; mixing of liquids and gases; fume and dust scrubbing; heating of liquids by direct contact; desuperheating of steam; and handling of slurries.

Many of these new applications should lead to new, and in some instances, to revolutionary developments in chemical engineering operations.

In the figure on p. 199 we show sketches of some jet apparatus. Some of the terminology used is confusing, but jet equipment con-

sists primarily of a diffuser, a converging nozzle for liquid-activated jets or an expanding nozzle for gas-activated jets. These are held in position by a properly-designed jet body.

The term, ejector, is now used to describe jet equipment involving liquids and/or gases. An ejector may be defined as a device wherein the kinetic energy of one fluid (primary, driving or motive fluid) is used to pump a second fluid (secondary or induced fluid). These ejectors discharge at a pressure intermediate to the motive and suction pressures.

The term, injector, is applied to special types of jet pumps, where a condensable gas is used to entrain a liquid and discharge against a pressure higher than either motive or suction pressures. These apply primarily to boiler feedwater units.

Liquid jet pumps using a condensable vapor such as steam as the primary fluid are often referred to as siphons. Eductors are liquid pumps that use liquid as the primary fluid. Exhausters are gas pumps where either a liquid or a gas is the primary fluid.

Jet blowers are used to pump gases against very low differential pressures. Jet compressors are used to boost the pressure of gases.

Ejectors of the venturi type may be used for either low compression or high compression. The term, low compression, is used where the density of the secondary or induced fluid is less than 10% of the average density.

Jet pumps, ejectors or exhausters are widely used in the chemical and petroleum industries. The applications include: exhausting of fumes; production of vacua for evaporation, distillation, crystallization, etc.; air conditioning, transporting slurries, pneumatic conveyor feeding; and moving large volumes of vapors, gases or liquids. The units are generally simple in design, involve no moving parts, require a minimum of maintenance, involve very low investment and operating costs.

Design Is Empirical

In the operation of a jet pump or ejector, at least several of the following mechanisms, plus others, are involved:

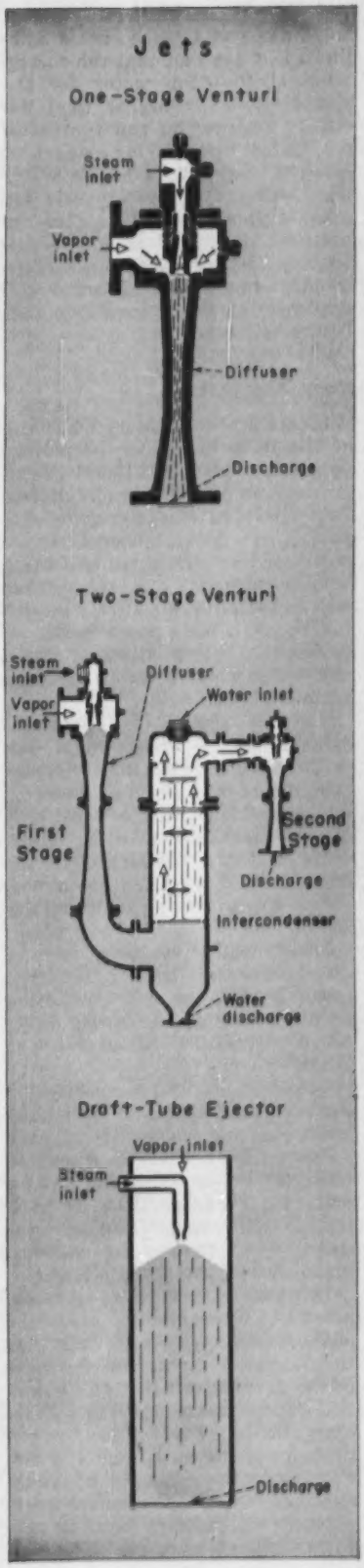
- Acceleration of particles of the secondary fluid by impact of particles from the primary fluid.
- Entrainment of the secondary fluid by viscous friction at the periphery of the jet.
- Change of state, such as occurs in a steam ejector where a large volume reduction results from condensation.
- Overexpansion of the jet to a pressure below that of the secondary fluid with corresponding flow of the secondary fluid toward the axis of the jet. The diffuser is so shaped as to gradually reduce the velocity of the mixed fluids and to convert the kinetic energy to pressure at the discharge with a minimum net loss in energy.

The draft-tube ejector, used only for low compression, involves a straight section of tube rather than a venturi shape. This ejector finds occasional use in industry when open steam or air is piped into a stack or duct. These operations are very inefficient. Jet siphons use steam as the primary fluid to pump heat and mix liquids and to handle granular solids and slurries. There have been many applications of air siphons for sampling operations.

Steam-jet siphons are especially suited to processes where heating as well as pumping is required, with heat provided by the condensation of steam in the liquid. Among the commercial uses are: pumping filtrate from vacuum equipment and condensate from condensers; periodic pumping of liquids from tanks; removal of water from circulating liquid and pickling baths; filling and emptying gas holders; and many others.

Liquid-jet eductors are similar to jet siphons except that water is used instead of steam as the primary fluid to cause the flow of the secondary liquid. Unlike jet siphons where an expanding nozzle is used, eductors involve the use of a converging nozzle. Commercial applications include the lifting, pumping, mixing and agitating of liquids and the handling of solids and slurries. Design is empirical including consideration of these variables: pressure, viscosity, temperature, density and the properties of the liquids.

In water-jet eductors, the secondary fluid is entrained by the high-velocity primary water and the mixture is discharged at a pressure higher than the suction pressure but less than the upstream jet pressure. Use of water jets for



handling gases such as air is limited by the fact that the energy required to pump water for the jets is normally higher than the energy required to run equivalent mechanical pumps or steam-jet ejectors. However, adequate water may be required continuously for other purposes where its pressure must be dissipated in any event. In this instance, the jet can serve a double purpose of ejector and condenser as in the countercurrent barometric condenser.

Many Other Uses

Steam and jet heaters make use of the jet principle in the mixing of steam with a cold liquid giving excellent agitation and circulation. The noise and vibration commonly associated with such operations are minimized or eliminated. All these heaters, including the tank type as well as the pipeline variety, involve a diffuser, a body and a nozzle or orifice. Steam or mixtures of steam and water under pressure are used as the primary fluids.

Pipeline heaters include: continuous units for direct connection to steam and water lines; instantaneous heaters; slurry heaters; and gasholder heaters. Tank type heaters include: noiseless units, units that are submerged in the liquid to be heated and use atmospheric air as well as high velocity steam and water to cut noise; sparger nozzles where a uniform distribution of heat over large areas is desired; and circulating units for heating and strong directional circulating action in open tanks.

Low-pressure, high-capacity jet heaters are available for providing large quantities of hot liquid, such as water, for delivery to a tank or reservoir. The injected water divides into fine particles by passing through spray nozzles, over trays or through the extreme turbulence of the liquid streams.

In water-jet exhausters and compressors, water issues from the nozzles at high velocity into the throat which forms the top part of the diffuser. Air or vapor enters the exhauster through the suction connection, is entrained by the pressure of the water and then discharges to the atmosphere. These exhausters use water under pressure as the primary fluid to perform vacuum pumping. They include single-nozzle laboratory vacuum pumps and multinozzle exhausters.

Water-jet exhausters have been used to prime centrifugal pumps, mix gases with liquids and exhaust air from filter boxes and cooking kettles. In the multinozzle type, six or more water nozzles carry water streams into the throat as a smooth, solid stream.

Barometric condensers are available in several types. Numerous combinations of parallel and countercurrent units, auxiliary air pumps, water sprays and water jets are used. Barometric condensers have a number of noteworthy advantages: they will not flood; injection water is discharged by gravity; and entrainment capacity is sufficient to insure high vacuum efficiency on equipment such as evaporators and vacuum pans.

Low-level, multijet condensers are designed to produce a high vacuum without the use of a separate air pump. Steam is condensed and air and other noncondensables are removed. Discharge is directly into a hotwell. This eliminates the need for a barometric leg. The water jets create a vacuum by condensing the steam and help maintain it by entrainment and removal of air and noncondensable gases.

The water in these multijet condensers travels at high velocity and does not break up into fine sprays. They have been designed commercially in conjunction with steam engines and turbines, cooling, drying, crystallization and deodorizing.

In low-level eductor condensers, injection water combines with internal vacuum to provide a jet with sufficient velocity to discharge through the narrow throat and diffuser to a hotwell against the pressure of the outside atmosphere. The water jet entrains the steam, condenses it and discharges the condensate along with noncondensable gases. The capacities are smaller than that of low-level multijet condensers and they are designed for medium or high vacuum for applications in industrial processes and for small engines and turbines.

Jet Scrubbers

Jet scrubbers are becoming increasingly more important. These scrubbers make use of a liquid to process gas that contains condensable gases, wettable solids and mixtures of gases and solids which can be cleaned by chemical reaction between the gases and solids and the selected spray liquid.

Wettable solid particles are removed by wet absorption or by physical knockdown. Nonwettable solids or wettable material too small to wash down are scrubbed by condensing water on the particles. Other special techniques can be used on nonwettable particles. We can add a wetting agent, recirculate the knockdown liquid or heat the liquid. Fumes that consist of liquid particles are removed by physical knockdown, absorption or reaction. Liquid particles are easier to knock down than solids.

Condensable gases are removed by cooling vapors below the condensation point in one or more stages. Condensable gases are also removed through absorption by the scrubbing liquid.

Fume and dust scrubbers are available in a variety of types; single nozzle, multinozzle and spray nozzle arrangements. All of these operate on the same principle with gases or fumes being drawn into the throat by the draft created by the spray nozzles or jet. Liquid and gas are mixed in the throat and discharged.

Another important type of liquid-gas jet equipment is the desuperheater. These are designed to reduce temperature of superheated steam to that required for process operations. The superheated steam is brought into direct contact with water, thus cooling the steam by evaporating the water. Related uses involve the atomization of liquids in gases for process applications.

These Are Only a Few

In the examples given above we have been able to discuss only some of the variations of jet equipment that involve some contacting of liquids and gases. Naturally, there are innumerable important applications of ejectors that involve only gases as primary and secondary fluids.

The inherent characteristics of liquid-gas contacting devices that incorporate jets—particularly venturi designs—emphasize the many important applications for this extremely interesting and versatile

technique. Theoretical considerations of the mechanism of a venturi scrubber and the removal of submicron particulate matter from gas streams indicate that many complex factors are involved. These include: collision and impaction; diffusion or molecular bombardment; electrostatic charge effects; and condensation.

An extremely important application of jets is for the vaporization of relatively high boiling or thermally unstable liquids into hot gas streams with subsequent rapid cooling of the hot gas. Absorption of such gases as NO and NO_2 in jet streams for the production of nitric acid appears to have commercial potential.

Incorporation of jet techniques in the design of various vaporizer, air conditioning, humidification, fluid mixing, transport and distillation equipment should be considered seriously for accomplishing liquid-gas contacting. It is very likely that the future will see further applications of the jet principle as modifications of component parts of existing equipment and, of even more significance, as complete replacements of packed, tray, spray and other equipment.

Vaporizers

The term, vaporizers, is used here in its broadest sense to include operations where one or more constituents are vaporized. Both direct and indirect heat transfer equipment are involved, although primary emphasis is placed here on indirect exchange units that involve heat transfer surfaces. A number of direct-contact heat exchangers that involve liquid-gas contact are cited and discussed elsewhere in this Report.

Vaporizers are used for operations that involve systems which are almost entirely in the vapor phase with very little, if any, inert or noncondensable gases being present. Vaporization phenomena are also involved in the humidification of air, quenching of hot gases, etc., but in these instances the ratio of noncondensable gases to condensable vapors is very large.

Processes where a single constituent is vaporized from the solution, as in the vaporization of water, were originally referred to as distillation. Generally, the term distillation is now restricted to operations where vaporization of a liquid mixture produces a vapor phase that contains more than one constituent. However, the operations are very closely related.

The two major categories of vaporizing equipment used in industry are boilers and vaporizing exchangers. Boilers are designed to convert fuel energy into latent heat of vaporization and involve direct-fired tubular equipment. Such equipment is highly specialized and does not have much relation to industrial liquid-gas contacting equipment.

Unfired Heat Exchangers

Vaporizers may be defined as unfired heat exchangers where one fluid is vaporized and where the unit is not part of an evaporation or distillation operation. The term evaporator is used to designate equipment where liquid (usually water) is boiled. Where the vaporizing exchanger furnishes heat requirements for a distillation process, as vapors to the bottom of a distillation column, it is designated as a reboiler regardless of the nature of the vapor produced. It will be apparent that the fundamental and design principles involved are very similar for vaporizers, evaporators and also for reboilers.

The broad variety of vaporizer problems faced by industry has produced a wide variation of mechanical designs. We will try to touch on many of them in the space at our disposal. For more details we refer you to a previous *Chemical Engineering* Report on "Evaporation" (April 1953, p. 227).

Autoclaves and kettles equipped with jackets or internal coils have become almost standard equipment for many chemical reactions or so-called "unit operations." These kettles are discussed further in the section on mechanical contactors, p. 205. While this equipment is very important, it is highly specialized and does not have too much in common with other kinds of vaporization equipment. The major trend in the design of autoclaves and kettles is to convert to continuous operation. In such cases, some of the factors discussed in this section on vaporizers would be applicable.

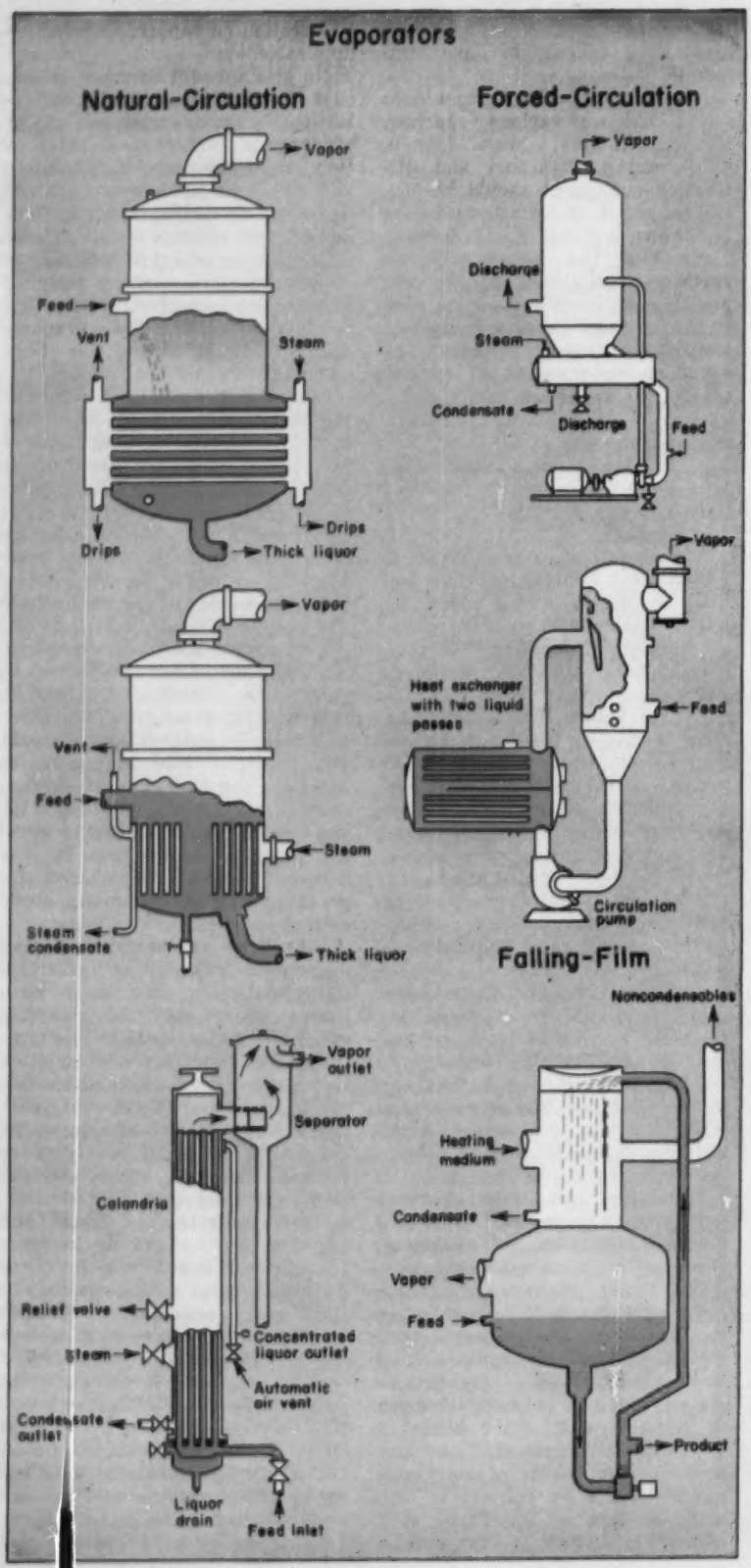
No attempt will be made to discuss in detail direct-contact vaporization methods such as solar evaporation, interphase evaporation and submerged combustion, although these are important liquid-gas contacting methods. New and efficient schemes have also been developed for effective distribution of hot flue gases into a body of liquid, with quenching of the hot gases and corresponding evaporation of liquid. This has been termed interphase evaporation.

Submerged combustion units use the burning of a flame below the surface of the liquid. Heat transfer is provided by radiation and direct contact of liquid with fine bubbles of hot gases. A major disadvantage of this technique is the difficulty of condensing the vapors—if their recovery is desirable—because of the large volume of noncondensable gas.

Two major kinds of vaporizers can be considered: power-plant units and chemical equipment. Power-plant evaporators include: heat transfer units designed to condense steam from high-pressure boilers; salt-water and process evaporators for the production of distilled water; and makeup units for supplying boiler feed. One or more effects may be involved, depending upon the particular application.

Vaporizing equipment, including evaporators, reboilers and other applications other than those mentioned above may be classified under two major headings: natural-circulation and forced-circulation exchangers. The natural-circulation units include most of the older types, some of which are illustrated on p. 202. In most of the older designs, the vapor spaces and the steam chest are about the same diameter, separation of liquid and vapor occurs by gravity and entrainment is coped with by using deflector plates and various entrainment separators. Liquids which tend to foam or scale present serious difficulty in these units.

Reboilers that use natural circulation include horizontal and vertical thermosiphons, kettle and chiller types, coils within a tower, etc. Many additional modifications are possible including once-through and recirculating techniques. Forced-circulation vaporizers in-



clude designs with vaporization in either the shell or in the tubes.

We believe that this method of classification helps illustrate the similarity and close relationship of vaporizers for various uses. The many permutations of available designs has given us a wide range of commercial equipment to choose from.

Evaporators

The major difference between power-plant evaporators and chemical units is that power plants want to produce pure water and they use blowdown for continuous removal of impurities. In chemical evaporators the unevaporated part of the original feed represents product and there is no blowdown.

The horizontal-tube evaporator has proven satisfactory for nonviscous solutions with little or no scale. The so-called standard or calandria-type evaporators may be equipped with internal agitators to increase circulation rates. Basket-type evaporators are quite similar to the standard variety, except that the heating element is removable for ease in cleaning. Internal agitators are often designed for these units also.

Long-tube vertical evaporators involve a single-pass heat exchanger with liquid inside the tubes and steam outside. The liquid-vapor separator is located above the tubes and a downtake for recirculation may be incorporated in the design. This evaporator occupies less floor space but considerably more headroom than others. The vaporization mechanism probably involves: a section where the tube is completely filled with liquid; an intermediate zone where vapor bubbles form and grow as they entrain slugs of liquid; and rapid flow of expanding vapor through the upper section of the tubes. Proper design of this type of unit can give a velocity and over-all heat transfer coefficient comparable to forced circulation.

The falling-film, long-tube vertical evaporator has been found to be particularly advantageous for viscous or heat sensitive materials. A well-known application is the production of frozen orange juice concentrate. Feed enters the top of vertical tubes and flows down the inside of the tubes as a thin film.

Liquid and vapor flow concurrently to the separator, although countercurrent flow can be provided as a special design.

Thermosiphon recirculating reboilers, unfired steam generators and long-tube vertical evaporators all operate on similar principles. The recirculation ratio, or ratio of liquid to vapor leaving the reboiler, is generally much higher with vertical as compared to horizontal thermosiphons. In thermosiphon-type units the frictional pressure drop in the reboiler and other resistances of the circuit must balance the hydrostatic head difference between the liquid and liquid-vapor legs.

Forced-circulation vaporizers have been developed for both evaporation and for distillation. Forced-circulation units involve considerably less headroom than natural-circulation designs and permit close control of feed recirculation. Natural-circulation designs eliminate the need for pumps and avoid stuffing-box problems. In evaporation, forced-circulation designs are required for very viscous materials or for solutions which tend to form scale or deposit salts. Both horizontal- and vertical-tube designs are used for reboilers and evaporators.

The Turba-film evaporator is an agitated falling-film unit designed to produce turbulence in a thin layer of liquid over the entire heat transfer surface. This particular unit might well be discussed under mechanical contactors, since it is similar in many ways to some of the other liquid-gas contacting equipment mentioned in that section. The equipment consists of an externally-heated vertical tube with a jacket along most of its length. It is provided with a central internal agitator that extends along the entire axis. The agitation and scouring action of the blades reduces scaling and salting on the tubes.

Advantages claimed for the unit include ease of cleaning and maintenance as well as simple startup and shutdown. The principal applications should be found in operations that require short contact times with viscous, heat-sensitive or delicate materials. The disadvantages include the relatively small capacity, requirement for internal moving parts and high investment cost.

Many Special Units

Many other new and specialized units have been designed for evaporation problems. However, the operating principles of these new designs are so custom-tailored to evaporation applications that there are no apparent applications in other liquid-gas contacting operations.

There are a number of commercial evaporators where vapor is evolved in a flashing operation under vacuum with latent heat of evaporation furnished by the sensible heat of the feed. Flash or equilibrium distillation, while using other equipment, involves the same fundamental principles. In flash vaporization operations, the liquid mixture is partially vaporized with subsequent separation of vapor and liquid phases.

As mentioned above, the two important categories of operations for commercial evaporation are: transfer of heat through retaining walls to the liquid phase with vapor removed in undiluted form; and the direct contact of liquid and vapor phases with vapor swept away by inert gas. The two major disadvantages of direct-contact techniques are: inability to apply multiple effects for good steam economy; and possible contamination from hot gases.

Spray Vaporizers

Substantial inroads on indirect heat transfer methods have been made by spray techniques, involving either direct contact with flue gas or indirect radiant heating or both. It is very probable that in the future many more indirect evaporation operations will be displaced by spray techniques.

The bubbling or sparging of hot gases through liquids can be considered a modification of the spray technique; in this instance with the gas phase dispersed in the liquid. Mechanisms of gas distribution, agitation, retention time, etc. are quite similar to those discussed in the section on spray units.

Actually, many of the gas scrubbers discussed in this Report, such as the sieve-plate and bubble-cap designs, involve precisely this type of bubbling of gas through liquid. Many of the commercial applications of such gas scrubbers also involve gas quenching and evaporation. These operations are quite similar in many respects to the phenomena obtained in submerged combustion.

An excellent example of the use of packed towers for evaporation is the concentration of dilute sulfuric acid by passing the acid down over packing, countercurrent to hot furnace gases. This particular application also serves to reabsorb volatilized sulfur trioxide at the top of the column. Principles of operation of such equipment are quite comparable to those discussed earlier for distillation and absorption.

Crystallizers

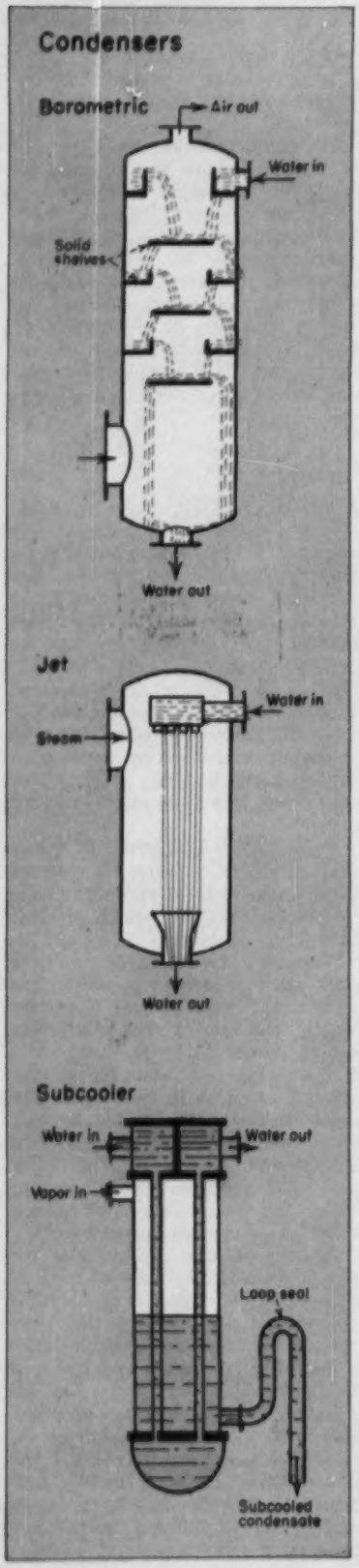
Crystallizers often use evaporation as a means for effecting supersaturation. The evaporation may be accomplished by cooling in adiabatic-operations. It is advantageous to consider as crystallizers those devices that produce crystals by cooling a solution, or in a few instances, by salting out a desired product. Equipment for the production of crystals by some form of evaporation should be considered as evaporators with special provision for handling and removing crystals.

Indeed, the last effect in many multiple-effect evaporation systems often includes an evaporator modified to handle solids which precipitate from solution.

Vacuum crystallizers involve flashing a saturated solution into a chamber with partial vaporization of the solvent. The solution is cooled adiabatically to the boiling temperature corresponding to the vacuum existing in the vessel. Because of the cooling action, as well as the evaporation of some solvent, solids will crystallize from the saturated solution. These vacuum units can be designed for either batch or continuous operation.

These crystallization methods are obviously modifications of principles used in other vaporization operations, with appropriate provision for handling precipitated solids in the desired form, size and uniformity.

As in the consideration of other liquid-gas contacting operations, it is often beneficial to consider the applicability to such evaporator-crystallizer problems, of jet, spray and other liquid-gas contacting equipment.



Condensers

Condensers represent an extremely important type of liquid-gas contacting equipment used most often in distillation and absorption operations. They are normally taken for granted in such operations. For example, in discussing fractionation towers, one usually assumes that they include some form of vaporizer or reboiler and condensing equipment.

Condensers are conveniently grouped into two categories: surface and contact equipment. Surface condensers are similar to tubular heaters. Vapor may be inside or outside the tubes although usually on the outside. Surface condensers may also act as partial condensers and be followed by other condensing devices. Condensate is kept separate from the cooling water, which has an added advantage in avoiding the introduction of permanent gases, as may be the case with direct-contact condensers.

Space does not permit even a superficial discussion of the many important details involved in the design of such units. A substantial amount of information is available in the literature, much of it due to the work of power engineers.

In some instances where the condensate is corrosive or where it is desired to recover the latent heat from the vapor by using it to preheat the feed to a distillation column, it may be desirable to condense the vapor inside the tubes rather than on the shellside. Horizontal or vertical arrangements may be used for such applications.

Surface condensers in the power industry are used to condense steam from the exhaust of turbines and engines. Since a turbine is designed primarily to obtain mechanical work from heat, maximum conversion is obtained by maintaining a low turbine-discharge temperature. If cooling water is available at about 70 F., a turbine will exhaust at perhaps 75 F., corresponding to a vacuum saturation pressure. This will require the apparatus to be designed for vacuum operation on the steam side.

Since the steam, as generated in power stations, is an extremely pure form of water free of scaling impurities, it is condensed on the shellside to permit more convenient cleaning of tubes fouled by cooling water. These condensers may contain well over 60,000 sq. ft. of condensing surface. In addition to the shell, tubes and water boxes there are other important parts such as large exhaust steam inlet ports, shellside air removal outlets and the hotwell equipped with condensate and air outlets.

In the condensation of steam with surface condensers, important factors are: velocity of circulating coolant water; cleanliness of the tubes; temperature differential; air on the steam side; extent of water blanketing; and variation of over-all coefficient in various parts of the condenser.

Most Are One-Two

The majority of surface steam condensers are modifications of the 1-2 exchanger and are referred to as *1-2 condensers*. Such an exchanger has one shell pass with the tube fluid in two or more passes. Numerous variations are possible, including both fixed tubesheet and removable tubebundles. Steam surface condensers are usually designed with ¾- to 1-in. dia. tubes, and with cooling water inside the tubes. Steam is introduced at the top of the condenser and condensate leaves the bottom of the unit.

In distillation operations, the condensing temperature determines the operating pressure of the distillation column. The overhead product must be condensed at a temperature sufficiently high so that its latent heat may be removed by the available cooling water. The size of this condenser is directly related to the temperature difference between the condensing vapor and the cooling water.

In many condensation operations both sensible heat and latent heat transfer are involved. Consequently, it is better to classify condensers in terms of phase phenomena inside the units rather than attempting even a superficial coverage of the many permutations of commercial designs.

What to Consider

The condensation of a single vapor, pure compound or constant-

boiling mixture may involve one or more of the following:

- Total or partial condensation of saturated vapor outside tubes.
- Desuperheating and condensation of vapor outside tubes.
- Condensation and subcooling of saturated vapor outside tubes.
- Desuperheating, condensing and subcooling inside tubes.
- Steam condensation.

Condensation of gas mixtures may include the following:

- Mixture of gases with short condensing range.
- Mixture of gases with long condensing range.
- Mixture of gases forming immiscible condensates.
- Mixture of noncondensable gases with condensable vapors.
- Mixture of noncondensable and condensable gases with the formation of immiscible condensates.

There are obviously so many possibilities for various applications that it is impossible to discuss them here even in a cursory fashion. The majority of condensers represent modifications of the familiar 1-2 heat exchangers.

There are several alternate schemes for condensing overhead vapor from a distillation column. For small fractionating columns, condensers are normally mounted above the columns and condensate returned to the system by gravity. In larger installations, the condensers are mounted below the top of the column and the reflux is pumped back to the system. Placing condensers at the lower level makes them more accessible for cleaning and reduces the size of the supporting structure. Partial condensers are used only to a limited extent.

Condenser-subcoolers may be either vertical or horizontal. Most industrial condenser-subcoolers are horizontal since over-all heat transfer coefficients are higher.

Barometric Condensers

Jet and barometric condensers provide direct contact between the vapors and cooling medium, which is usually water. Both types have vapor chambers where condensing and cooling water is divided into fine sprays or cascading sheets through which vapors pass. The jet condenser, sometimes referred to as a low-level condenser, involves the removal of condensate by means of a pump. Barometric condensers involve removal of condenser water from the condensing chamber through a tailpipe 34-ft. long, commonly known as a barometric leg.

Barometric condensers usually involve countercurrent flow with separate removal of condensables. Parallel-flow barometric condensers have been used to a limited extent where the noncondensable gases are compressed and entrained with the liquid, the bubbles traveling down the cone and tailpipe. These units can be used only where the amount of noncondensables is not excessive.

Condensate Removal

Condensate can be removed by traps or pumps. Self-priming pumps are usually used on large evaporator installations. Traps are used for removing condensate from all types of steam-heated equipment such as kettles, heaters, coils, evaporators, etc.

Mechanical Contactors

In this last section we'll discuss liquid-gas contacting equipment that involves various mechanical devices to achieve more efficient contacting of liquids and gas phases. Such units are commonly found in commercial operations where chemical reactions occur. Other applications are found in absorption, humidification, dehumidification, vaporization and gas scrubbing.

In the design of gas absorption equipment, for example, there are a number of mechanical factors to be considered which make mechanical contactors competitive or even superior to packed, tray and spray towers (or to jets or other alternate methods) for certain applications. Among the important factors are: presence of solids in suspension; quantity of solids present or formed during the reaction; relative amounts of gas and liquid phases; rate-controlling mechanisms, whether kinetics or diffusion; corrosion characteristics; and pressure, temperature and other conditions.

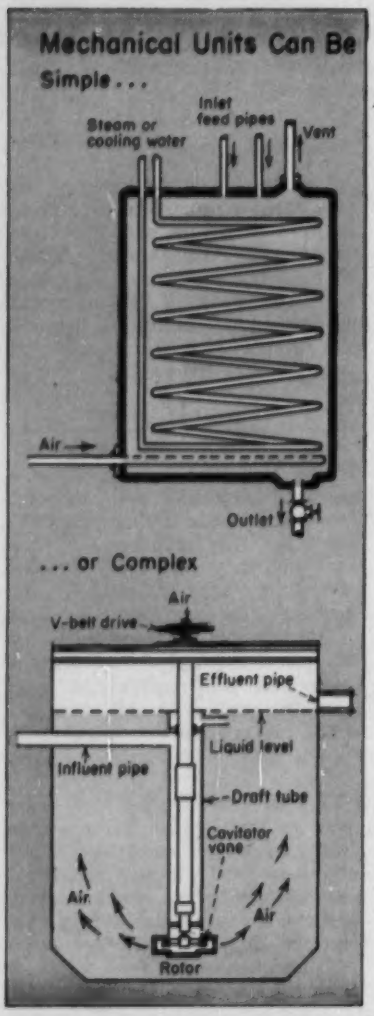
Intimate mixing is extremely important for heterogeneous catalytic reactions, where solids are present in suspension and efficient contact of gas and liquid phases is important. Examples of such operations are quite numerous and include a large proportion of what have been commonly termed "unit processes"—hydrogenations, chlorinations, brominations, aminations, reductions, sulfatizations, etc. Mechanical agitators are almost always preferable for such applications.

Turbine gas absorbers have been used to promote contact between gas and liquid phases. Contact is improved by providing a relatively long gas path through the liquid phase under vigorous agitation. This unit involves constant distortion of the gas bubbles as well as rapid renewal of the liquid at the interface. In some instances gas is pressure fed to the lower of a series of absorbers on a single shaft and recirculated from above the surface by self-induction of the top impeller. In other cases the gas may be self-induced at the surface.

Vessels with two or more gas-absorber units have been widely used for pressure operations. They have been used for many chemical reactions including hydrogenation of unsaturated hydrocarbons, reduction, oxidation, halogenation and many other reactions. In these units the gas usually enters under the bottom section and passes through the various zones, leaving at the top. The top impeller may actually serve to suck back the gas into the liquid to assist in providing complete absorption. Many variations of gas disperser agitators have been designed.

In the so-called cavitation method (see figure next page) the gas is dispersed mechanically by agitated liquid having sufficient force to produce regions of cavitation. The gas to be dispersed is introduced into these regions. This unit uses a hollow-bladed impeller mounted on a hollow shaft below a draft tube.

In general, for applications where the amount of gas is tremendous as compared to that of the absorbing liquid (as in the stripping of acid vapors and ammonia from gas streams) towers or gas scrubbers are preferred. Mechani-



ical gas absorbers within vessels are not suitable since they involve the pumping of mixtures of liquid and gas phases through the impeller.

Where the amount of solids that are precipitated during a reaction are relatively high, mechanical devices, wet scrubbers and jets are more desirable than tray or packed towers.

Efficient Agitation

Considerable progress has been made in the development of more efficient mechanical agitating equipment that incorporates rotating turbines, paddles and propellers. Various arrangements of baffle and stator designs are used to minimize liquid swirl and to provide optimum shear. For example, sub-aeration froth-flotation units involve a vigorous agitation of a mixture of ore pulp and air. The air may be induced either through a sparger device or through a hollow agitator shaft. The air may be either self-induced or pressure-fed.

Many typical halogenation operations involve the use of liquid-gas contacting. As an example, consider this method used to prepare chloroacetic acid. Glacial acetic acid and red phosphorus are put into the chlorinator and chlorine is added gradually. Steam or water is used in the jacket of the vessels to hold the desired temperature. The best yields are obtained with a liberal excess of chlorine induced over a long period of time.

Another illustration is a method for the chlorination of benzene. Dry benzene is fed to the unit, which usually consists of tall cast iron or steel shells that have been lined with lead. Agitation may be provided either by a mechanical device or by external pumping. Chlorine is distributed in the bottom of the reactor through a perforated tube. Iron is usually employed as the catalyst. The rate of chlorine addition is determined by the temperature control. Since the monochlorobenzene is generally the desired product, conditions are adjusted to terminate the reaction with an excess of unreacted benzene.

A typical batch unit (see sketch above) can be used for the liquid-gas contacting operation of oxidizing acetaldehyde to acetic acid. The acetaldehyde is added, together with a solid catalyst to the vessel. Air passes through the distributor head and steam is used to raise the temperature to the operating point. When the reaction starts, cooling water is substituted for this steam to remove the exothermic heat of reaction.

The few examples above are all space permits. They should suffice to illustrate the general procedures used to conduct batch or continuous conversions of chemical compounds, where liquid-gas contacting is the predominant factor.

Various kinds of kettles and autoclaves are used commercially. They are provided with inlets for adding reactants; mechanical, gas or circulation agitation; jackets or coils for heat transfer; and condensing arrangements that minimize the loss of volatile materials.

Mechanical Scrubbers

Many mechanical devices have been developed for scrubbing dusts and mists from gas streams.

In one, a rotary spray device, liquid is thrown tangentially from a rotary sprayer element and strikes a conical apron on the shell to create a dense spray. Recirculation is established in each spray chamber and the units are usually multistage, each stage consisting of a spray chamber. The rotary element is mounted on a central shaft and the units can conveniently handle gases that are heavily loaded with solids. They are often used before a final cleanup.

In another recently developed unit, blast furnace gas together with scrubbing liquid is passed outward through a series of rotating and stationary arms.

Obviously, bubbling gases through liquids does not result in very efficient dust removal because of poor liquid-gas contacting and relatively short retention time. Various mechanical devices, such as those cited above, have been developed or proposed to provide good gas dispersions.

Spargers

Sparging installations actually vary from relatively simple units used to agitate large tanks to fairly complex gas-distribution systems. For chemical conversions such as halogenations, with or without catalyst, open-end pipes are often used to introduce gas. In addition, mechanical agitation may also be required.

For most absorption operations, such simple sparging equipment is not adequate. The use of porous plates, tubes and other distributors is designed to produce much smaller bubbles at the expense of larger pressure drop across the distributor. In general, porous distributors are as effective as mechanical agitators at relatively low gas rates but are inferior at high gas rates.

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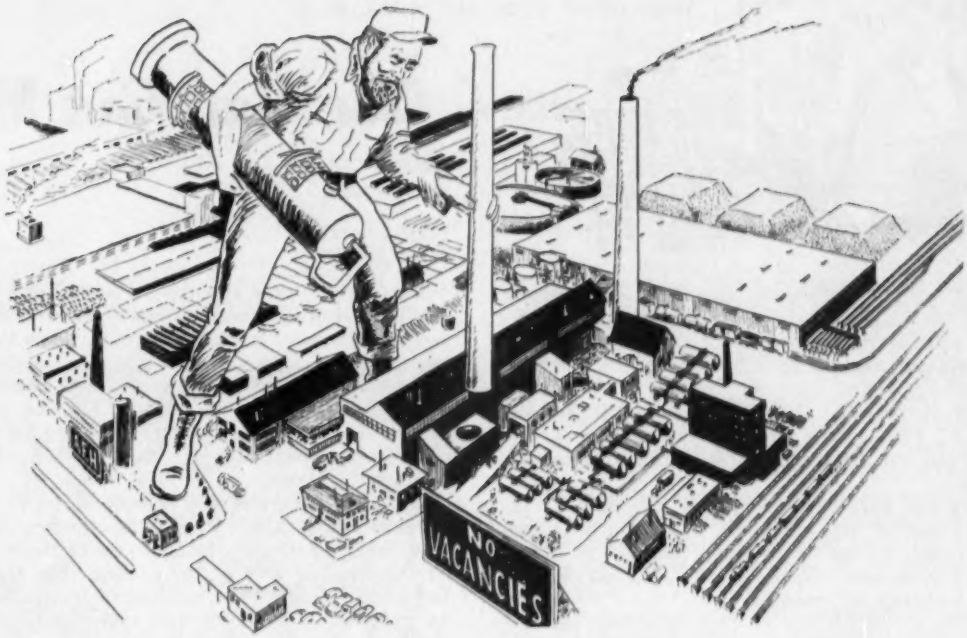


Take a New Look at

The Engineering Shortage

Articles analyzing the current engineering shortage pepper the lay and professional press. Most often they offer solutions that hinge on increasing, in one way or another, the numbers of engineers available to industry. In the following article consulting engineer H. Leslie Bullock explores another aspect of this crippling problem.

Expanding industry, Bullock points out, hungers for more engineering. And it doesn't care very much how many engineers feed it—as long as it's fed. Industry would be content with one engineer, of Paul Bunyan's caliber, if he could satisfy its gigantic need for design, research, development, etc.

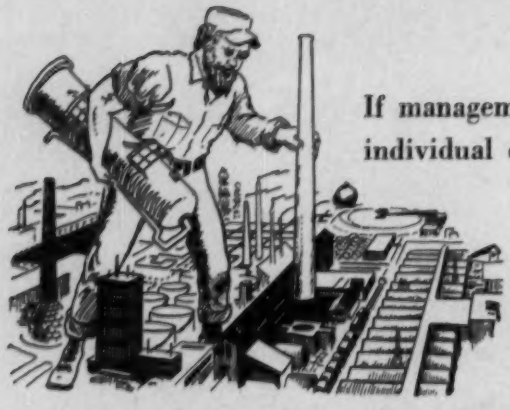
We face a shortage of engineering. And we'll beat it when we find ways to supply more. One way is to swell the pool of engineers. A long-range and important solution its effect, however, may not be felt for many a critical year.

Another way promises immediate, if only partial, relief. Boost the amount of engineering turned out by the existing pool of trained personnel, make each one more of a Paul Bunyan. Striking directly to the problem's heart it offers each engineer the chance to fully exploit his talents and brighten his career.

Responsibility for implementing this approach rests squarely on the shoulders of management, supervision and individual engineering. Top executive's part: To insist on and reward quality performance. Squad leader's part: To coordinate and direct their engineers to that goal. And each engineer's part: To strive towards it in fairness to himself, his profession and his country.

Our engineers, Bullock feels after long and intimate association with the profession, are just not realizing their full potential. Improve their efficiency, fully utilize their skills and kick up their output. Then they will heighten their personal success and take us a long way out of the shortage right now. On the following pages he tells us how.

THE EDITORS



If management, supervision and the individual engineer work at it . . .

We Can Get More

TODAY industry cries out for more engineering and the long range solution—more engineers—doesn't provide relief soon enough. Industry needs immediate help. And it must come from our existing supply of engineers.

Nearly 40 years of close association with a wide variety of engineering projects has convinced me that we can get more and better engineering out of our men.

During the past 10 or 15 years, it seems to me, the efficiency of our engineers has fallen off, and a dangerously lax mood has set in. A little of it can be ascribed to laziness, disinterest and the all too human tendency to "pass the buck."

But the great portion of this condition springs from a failure on the part of our engineers to realize the full scope of their responsibility. Increased specialization, necessary though it is as our technology becomes more and more complex, has lessened the engineer's grasp of the over-all project picture. It has narrowed his attention only to parts and details. Quality and efficiency do not flourish in such an atmosphere.

Especially victimized by this mood are the younger engineers. Their progress is often impaired and all engineering suffers with them. Engineers must have a personal interest in the total problem even though their part in its solution may be small and extremely specialized. Pride in their work stems from pride in final assemblies and the quality of materials produced.

It's up to management to insist on, recognize and, particularly, to handsomely reward top quality work. And the lower rungs of supervision, group leaders, project chiefs and the like, must urge and direct such performance. They must give their engineers the information and personal contact with each project to foster a healthy and interested attitude.

Finally a share of improving our engineering efficiency lies with the individual engineer. He owes technology, his profession and especially his own career to cultivate the habits of excellent engineering.

A good engineer needs an inquiring and skeptical mind. But skepticism should not be carried to prejudice.

In checking on a unit's failure, a machine breakdown, unexpected noisy operation or poor quality production he'll never accept the first story told to him. Nor, in fact, his own first judgment. He'll reach a conclusion only after careful thought and thorough investigation.

But a few years ago, at the scene of a mixture explosion, I was handed an elaborate report on the accident's cause. It attributed the trouble to "breaking of a cast iron crank." When this crank broke it presumably allowed a heavy muller wheel to drop on pressure sensitive material. Thus the explosion. The report writer assumed that the so-called crank could rotate and raise the muller wheel above the mixture.

Actually the crank was merely a draw bar with no keyways to allow it to raise the muller wheel. And, what's more, the tension side of the break was on the opposite side of the casting than that specified in the report. The position of the muller wheel, as revealed in a photograph taken right after the accident, supported these facts.

Further investigation, no longer influenced by preconceived ideas, showed that the mixer was operating at over twice the speed considered safe for the sensitive, explosive mixture. It was the only high speed unit in a battery of mixers. And the others, run at the proper speed, had never given any trouble.

A skeptical mind is an inquiring mind, while a prejudiced mind is a narrow and often ignorant one. If you find that you are prejudiced against something make sure that you thoroughly understand it.

A good engineer knows the sights and sounds of correct plant operation. Any divergance tips him off to trouble.

I visited a plant a short time ago in which an elaborate control system operated through small variations in d.c. voltage. Operation was reported as erratic. When I walked into the plant, still some twenty feet from the apparatus, the trouble was immediately apparent. The armature of the d.c. generator, producing the control current, was sparking badly. The five plant engineers with me had passed the location many times while the trouble was devel-

By H. LESLIE BULLOCK, Engineering Consultant*

Engineering, Right Now

Six stories, culled from the author's experience, show how to remedy the bad habits that slice engineering output.

oping. But they had not noticed the sight of the flickering light or the sound of the defective commutation.

A good engineer familiarizes himself with all the physical limitations of a new machine or process.

Every one connected with a particular project should know its exact location in the plant and its complete product specification. Each member of the squad should be acquainted with the controlling factors and he should understand the over-all project as well.

I once sat in on a conference concerned with the impregnation of high-voltage electrical components. Every one there was expected to be familiar with the process. No one in the group present knew the degree of humidity which could be allowed in the drying, impregnating or curing sections. No one had calculated the open volume satisfactory for vacuum drawdown. No one knew clearly the polymerization or curing time. All this information should have been gathered and checked before they brought in the outside equipment supplier. Instead it took three visits, over a period of two weeks, to obtain complete and accurate information from which the supplier could work.

A good engineer adopts a cosmopolitan attitude when developing or improving processes and techniques.

Competent engineers recognize that at school they were taught by means of rather isolated examples selected for their ease of demonstration and spectacular qualities. They were not necessarily the most efficient or safest methods. On the job literature searches and questions to co-workers will help engineers, especially recent graduates, to determine the best methods.

In the college lab, for example, the embryonic engineer probably learned to associate reduction with hydrogen. But in industry he needs to think of reduction as a complete or partial elimination of oxygen. And that it can be accomplished by a number of gases, liquids or solids best suited to the process under consideration. In school, his contacts with dispersing agents and protective colloids no doubt were confined to the formation of oil-in-water emulsions. In his plant work he must remember that they apply to the dispersion of solids, to the prevention of aggregate formation following fine grinding and to emulsions of the reverse water-in-oil type.

I have seen plants fail to recognize and apply these principles. One operated with high cost, explosive hydrogen when a cheap, safe liquid or solid reducing agent would have been equally effective. I've seen sulfur come from a wet grinder in the form of aggregates larger than the feed. And pigments leave a colloid mill in the form of tough aggregates unsuited for further dispersion in the carrying vehicle.

Competant lab instruction teaches the young engineer to gather his samples with clean utensils and to place them in clean containers. The virtue of cleanliness only protects against immediate outside contamination. It does not protect against the changes in a sample due to faulty handling.

Unfortunately, it's not uncommon to find supposedly good chemists who leave samples loosely corked so that evaporation or oxidation could alter the composition of the sample. I have seen minute samples stored in large bottles where they were exposed to enough oxygen in the container's air to change their grades.

I have seen a chemist, working on the dispersion of sub-micron particles, smear a sample in the form of a thick layer on a glass slide and allow it to dry in the open air. When he looked at it under the microscope he had to report a gritty and unsatisfactory dispersion. Yet a sample taken from the same batch, placed on a glass slide and covered immediately with a tightly pressed cover glass would show an extremely fine dispersion, with no visible aggregates.

A good engineer does not believe all activity is good activity; or that words are substitutes for deeds.

Hours of discussion can never determine whether there is clearance for a machine in a particular spot. Only an up to date, correctly dimensioned

* Meet your author on page 375.

print or the actual physical measurements will tell. Activity should be directed to produce results in the most accurate manner and minimum time.

Not long ago I sat for an hour and a half in the drafting room of a large company while a group of men looked for a drawing. They hoped that it would show the clearance between two machine supports. I knew that the equipment was on the next floor. I told them that I was going up to measure the clearance if my pass was good for that location. They ok'd the move and I had the desired information within five minutes. It took me longer to sell the idea of direct action than to get the information.

A good engineer uses his senses of hearing and touch along with his brains, his eyes and his muscles.

Shortly after installing a heavy vibrating screen in a large chemical plant, I received word that it was out of balance. It could not be operated for fear of knocking the building apart.

At the plant the chief engineer, chief draftsman, plant superintendant and a division foreman accompanied me to the starting switch, directly under the screen. We stood on a steel floor and the screen was supported on a framework about fifteen feet above our heads. They started the unit and at once I was forced to rock forward on my toes to save my system from a bad shaking-up. The jarring was clearly too sharp and too violent to be the result of an out of balance condition. I signaled them to stop the unit and climbed the ladder to screen level.

There I found a square pry bar bridging the support steel under the screen. Its position was such that the heavy screen body struck it with every stroke. With the unit operating at 1,250 rpm. you can imagine the magnitude of the disturbance. I pulled the bar loose, threw it none too gently to the floor in front of the non-investigating committee's toes and asked them to start up the machine again. It ran with a smooth purr in the glowing light of their four very red faces.

In another plant eight identical units, for identical purposes, were installed side by side. Five were reported satisfactory, three defective. An associate of mine traveled over 175 miles to inspect them with the operating crew and plant engineers. The inspection did not take long. The five satisfactory units were running in the correct direction, the others weren't.

It's common to find single machines operating in the wrong direction when there is no basis for corrective comparison. But it calls for extreme disinterest to fail to see the difference in running characteristics in three out of eight adjoining units.

These examples bespeak poor thinking, inattention, carelessness and lack of constructive supervision.

In themselves they do not represent crises. But they unfailingly promise low efficiency and low quality performance. Engineers, and particularly susceptible newcomers, need to acquire the correct viewpoint and develop the right habits. Three qualities—engineering knowledge, initiative and common sense—must permeate their spirits and be exercised with pride and loyalty to their profession.

Engineering knowledge means the coordinated fund of engineering lore that permits the engineer to apply the facts learned at school to the real problems of the field. Unfortunately it is the kind of knowledge that is very difficult to acquire in the classroom. It must be gained, almost entirely, from contact with squad leaders and sympathetic, well-informed engineering supervisors, and from actual plant experience. Every rung of the supervision ladder must take the responsibility of teaching the men the subtleties, the empirics, the know-how gained from actual practice.

Initiative can be taught and developed in the classroom by professors who have not grown moldy from ivory tower existence. But it must be further developed in industry. The engineer must be allowed to use it in his work. And management must recognize it and reward it. Methods that are too ironclad, duties that are too automatic, questions that are discouraged or restricted will never develop initiative. Supervisors must welcome and encourage ideas from their men, evaluate them and try them if deserved.

Common sense is a more elusive quality. It is rarely susceptible to cultivation if it is not already present in the engineer. An engineer with common sense realizes that principles apply to all of nature and not just to the illustrations on the pages of textbooks. He quickly sees their applicability to real situations.

Squad leaders promote these qualities by making detailed and clear analyses of current problems and by discussing them with the men. Management recognizes excellent performance with real promotions and increases in responsibility and income.

A machine or a process does not grant wishes like a modern Aladdin's lamp with a wonderful genie.

A machine or a process is an inanimate creation that must be set up and operated correctly. It must be supplied with selected materials under controlled conditions. And its product must be removed under proper conditions that protect its quality. Regardless of what his job is, the individual engineer must have a feeling for the entire line and flow.

First-hand knowledge of the plant and its environment helps. He should see samples of the product at different stages of manufacture and apparatus being replaced or improved.

The triad of the individual engineer, the group leader and management together can improve the quality and efficiency of our engineering. And together, accepting their obligations, they can eliminate a good deal of this talk of shortage.

LINEAR PROGRAMMING

What Can It Do?

Previously many complex interlocking conditions in this chemical plant were established by experience or intuition. Now, with linear programming, operating conditions are precisely set for maximum profit.

H. T. SCHWAN and J. J. WILKINSON, Methods Engineering Council, Pittsburgh, Pa.*

Chemical engineers frequently face unusually complicated and nettling problems in deciding how to get the most profit out of their facilities.

As a rule they are restricted, except for quality variations, by the input of processing units. They are frequently faced with fixed yields of byproducts—some of which they would be glad to do without. They have choices as to actual processing in some cases, and in others, choices as to processing costs which are controlled by the age or type of equipment available. Then, in nearly all plants, there are the problems of handling capacity, storage capacity, and salability at different price levels of end products and byproducts.

Deciding what to do in these situations has of necessity been difficult—so difficult in fact that much decision making could more realistically be called "guesstimate," intuition, or hope. If the company continued to make a profit the assumption is that the decisions were at least satisfactory. But there remains the question, "Was it the most profitable decision that could have been made?"

One chemical processing unit, a tar plant operation, has recently started using a technique of operations research—linear programming—and some remarkable results in increased profits and more effective operations have been obtained.

What Is It?

Linear programming has been used previously with excellent and even spectacular results on such problems as:

- Most profitable manufacturing program.
- Best inventory strategies.
- Effect in changes in purchasing and selling price.
- Most profitable product mix.
- Best location of plants.
- Best location of warehouses and distribution outlets.
- Lowest cost machine or manufacturing schedule.

From looking at the above type of problems and asking yourself these questions you can tell whether or not you have a problem that can be handled by linear programming:

1. Are you required to decide on one course of action from among several alternative courses?

2. In making this decision are you seeking the best of the alternatives in terms of a definite objective such as lowest cost, greatest profit, best utilization of equipment, or some other optimum condition?

3. Are there many factors and restrictions to consider in arriving at a decision, and are these factors interrelated? For instance, in your processing plant if you make X units of product A *must* you make Y units of byproduct B. Or, if you decide to make X units of product A must you limit your output of product C to Z units?

4. Can you express these factors or variables that affect the problem in a quantitative way with linear functions?

What can linear programming do? It is both an approach to the statement of a problem and a set of mathematical procedures for solving problem data. It helps management:

- Organize the facts and information about a problem.
- Analyze all possible alternative solutions to the problem.
- Select the best course to follow under its own conditions and limitations.
- Plan the specific program required to get the best results.
- Re-evaluate the program when conditions change.

The real skill and ability needed for successful application of linear programming is in setting up the problem so that it truly reflects the actual operating conditions and restrictions of the specific situation. The computational work can all be done with simple arithmetic using mathematical techniques such as matrices. Only the most complicated problems require any more than the usual calculating machines found around most offices.

Let's consider a simple problem. Assume we have an oil company with refineries at Bayonne, Chicago, and Texas City. These refineries have to supply tank car shipments of gasoline to six major distribution points at Tulsa, New Orleans, Cincinnati, Knoxville, Atlanta and Baltimore. The table shows the producing capacity of the three plants, requirements of the six distribution points, and freight costs.

The management of this oil company wants to use its plant capacity to fill the needs of the distribution points. At the same time freight costs must be kept to a minimum.

Inspection of this shows that it meets the previously mentioned requirements of a linear programming problem. An objective, lowest freight costs can be stated. There are almost an infinite number of choices as to what shipping schedule to follow.

The table shows the best shipping schedule that results from applying linear programming. See p. 215 for an explanation of the

* Meet your authors on page 372.

mathematics behind linear programming.

Tar Plant Application

One of the most interesting and profitable applications of linear programming we have had is in a tar plant chemical operation. This application—a product mix type of problem—enabled the plant management to calculate a complete production or operating program for the plant, and to measure the profitability of the program. They can do this for any type of sales or production requirement. The new procedures for programming the plant allow management to evaluate the profitability of any proposed change in marketing or operating conditions.

Accuracy and speed in calculation of new programs was important in this installation due to frequent changes in production and sales requirements as well as variations in selling prices and material costs. Using a modified and simplified form of linear programming, a new program can be worked out completely in about two hours without the use of expensive or hard-to-get computing equipment.

We must stress, however, that one reason for increased accuracy and confidence in the results is that, for the first time, accurate and up-to-date information on costs, profits, yields, and capacities is available. The collection and verification of the needed information accounted for a good part of the installation time.

The problem was to program a tar plant operation where crude tar is processed, yielding twelve endproducts (see flow diagram) such as naphthalene, pitch, meta-para-cresol. This tar can be processed by four different "conditions."

Yields of endproducts are interlocked. Also each endproduct may have two different uses, one which results in profit, one in less profit or a loss.

The endproducts are produced in a fixed yield relationship to the tar used and to each other. That is, if 10 gal. of naphthalene are produced under one "condition," we produce—with no possible change or variation—58 gal. of pitch and 1 gal. of meta-para-cresol, as well as fixed quantities of all other endproducts. Any one endproduct may be sold at a profit which fluctuates with market conditions, or may be disposed of at less profit, or at a loss, as a fuel.

Interlocking Variables

Tar from coke ovens is fed into the Creosote Department where there are four stills with four "conditions of operation." Certain stills may only operate under certain "conditions" and one still is limited to one fixed "condition." These "conditions" mean that different yields of endproducts result when different conditions of operation are used. Following the flow diagram we see that pitch, net creosote, and carbolic oil come from creosote stills.

Actually, three types of pitch are produced; some output is sold and some is disposed to pitch tar mixture for a fuel, and sold at a loss. The net creosote is blended with drain oil and some of the production is sold as low residue creosote and regular creosote.

The carbolic oils go through a series of processes involving the #1 Tar Acid Department, the #2 Tar Acid Department, and the Naphthalene Department. The endproducts from these carbolic oils include naphthalene, drain oil for blending, benzol products, and refined tar acids such as phenol, ortho-cresol, meta-para-cresol, and xylenol.

For an added measure of complexity, these tar acids may also be produced from byproduct phenolate, purchased phenolate, and purchased crude tar acids.

Certain assumptions were made, and steps taken, to simplify calculation. Briefly:

1. Fixed costs of operation were

Data on Hand

Refinery Production (max. cars/mo.)		Requirements of Distribution Points (cars/mo.)			
A. Bayonne	5,000	A. Tulsa	1,000	D. Knoxville	2,000
B. Chicago	3,000	B. New Orleans	4,000	E. Atlanta	2,000
C. Texas City	10,000	C. Cincinnati	6,000	F. Baltimore	3,000

Freight Costs (Dollars Per Car)

Refinery	Distribution Points					
	A	B	C	D	E	F
A	3	3	2			
B	4	1	1			
C	2	2	5			

Possible Shipping Schedules

Minimum Cost But Impractical

Refinery	Distribution Points					
	A	B	C	D	E	F
A						3,000
B		4,000	6,000			
C	1,000			2,000	2,000	

Total freight cost = $19,000

Practical But Relatively High Cost

Refinery	Distribution Points					
	A	B	C	D	E	F
A		4,000	1,000			
B			3,000			
C	1,000		2,000	2,000	2,000	3,000

Total freight cost = $39,000

Best Schedule With Linear Programming

Refinery	Distribution Points					
	A	B	C	D	E	F
A			3,000			2,000
B			3,000			
C	1,000	4,000		2,000	2,000	1,000

Total freight cost = $27,000

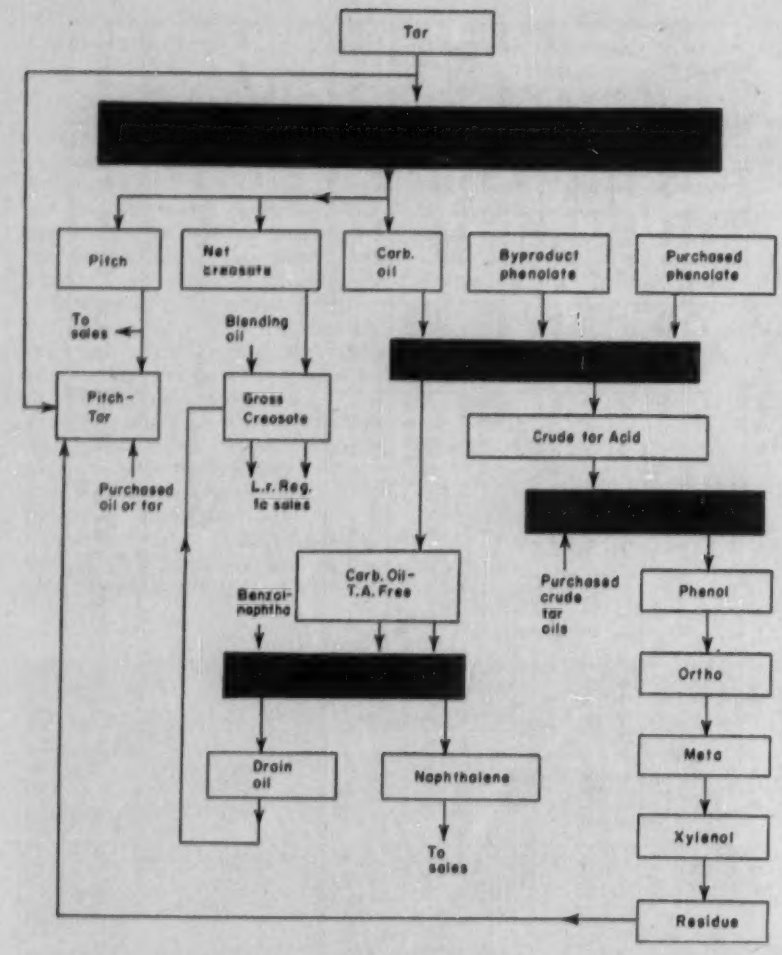
Linear Programming a Tar Plant Chemical Operation – *A Typical Profit Calculation*

Conditions I + II + IV Cannot Exceed 130,000 gal.

Yield/Gallon of Dry Tar Distilled (@ actual Btu.) 160,000 gal. of dry tar per day throughput

Condition	Condition Capacity gal./day	Loading gal./day	Naphthalene	Drain Oil	Phenol	Ortho-Cresol	Meta-Para Cresol	Xylenol	Reg. Creo. Heavy	L. R. Creo. Heavy	Soft Pitch	Hard Pitch	Fibre Pitch	Benzol Products	Profit Per Day
I	130,000	73,760	0.080 5,901	0.090 6,638	0.010 738	0.004 295	0.008 590	0.006 443	0.300 22,128			0.400 29,504		0.020 1,475	
II	130,000	50,240	0.040 2,010	0.050 2,512	0.006 301	0.003 151	0.007 352	0.006 301		0.200 10,480		0.600 30,144		0.020 1,048	
III	30,000	30,000	0.050 1,500	0.040 1,200	0.005 150	0.002 60	0.007 210	0.006 180			0.800 24,000			0.020 600	
IV	6,000	6,000	0.060 360	0.050 300	0.006 36	0.003 30	0.007 42	0.006 36		0.170 1,020			0.500 3,000	0.020 120	
Total Production		160,000	9,771	10,650	1,225	536	1,194	960	22,128	11,500	24,000	59,648	3,000	3,243	
Sales demand-average per day			Max.	6,000	2,000	700	1,800	1,000	3,800	11,500	2,400	—	3,000	Max.	
Production to sales			9,771	6,000	1,225	536	1,194	960	3,800	11,500	2,400	—	3,000	3,243	
Production to pitch tar mixture			—	4,650	—	—	—	—	18,328	—	21,600	59,648	—	—	
Production under sales demand			—	—	775	164	606	40	—	—	—	—	—	—	
Profit/gal. to sales			$0.20	$0.10	$0.60	$0.50	$0.70	$0.40	$0.10	$0.10	$0.05	$0.00	$0.08	$0.09	$
Profit for sales demand			$1,954.20	$ 600.00	$ 735.00	$ 268.00	$ 835.00	$ 384.00	$ 380.00	$ 1,150.00	$ 120.00	—	$ 240.00	$ 291.87	6,958.87
Profit/gal. to pitch tar mixture			-$0.04	-$0.01	-$0.07	-$0.07	-$0.07	-$0.06	-$0.02	-$0.02	-$0.005	-$0.005	-$0.005	-$0.000	$
Profit to pitch tar mixture			—	-$46.50	—	—	—	—	-$366.56	—	-$108.00	-$298.24	—	—	-819.30
Profit/gal. under sales demand			-$0.20	-$0.10	-$0.60	-$0.50	-$0.70	-$0.40	-$0.10	-$0.10	-$0.05	-$0.00	-$0.08	-$0.09	$
Profit under sales demand			—	—	-$465.00	-$82.00	-$424.20	-$16.00	—	—	—	—	—	—	-987.20
Benzol Naphthalene	Capacity 1000 gal. per day	Loading 1,000	0400 400	0.500 500											
Profit/gal. to sales			$0.20	$0.10											$
Profit for sales demand			$80.00	—											80.00
Profit/gal. to pitch tar mixture				-$0.007											$
Profit to pitch tar mixture				-$3.50											-3.50
Total net profit from tar distillates and benzol-naphthalene			$ 2,034.20	$ 550.00	$ 270.00	$ 186.00	$ 411.60	$ 368.00	$ 13.44	$ 1,150.00	$ 12.00	$ -298.24	$ 240.00	$ 291.87	$ 5,229.87

Total net profit per day



extracted by careful analysis from the profit or loss per gallon. These fixed costs were deducted from the final profit figure at the end of the calculation.

2. Production cost in a given department or cost area is spread equally over *all* products from that area.

3. Actual measured yield figures were used—process loss and wastage was not shown in the matrix since no profit resulted from these items.

4. Figures were based on a gallon of *dry* tar.

5. The methods of operating the tar stills—referred to as "conditions"—varied with the mechanical construction of the stills, as well as the operating practice (temperature and the like).

The Creosote Department is the department with limiting capacity or "bottleneck" and, hence, was the only area actually programmed.

Departmental capacities are limited by individual pieces of equipment and simple programming procedures can be developed for each case, if required, for any future changes in equipment or increase in capacity of the Creosote Department.

Programming the Operation

It would be impractical in an article such as this to attempt to describe the linear programming computations. The sample matrix will give you an idea of the computations. All of the matrix in the beginning is blank except those column headings and other squares which are shown in type. The figures put in by hand are the results of the computations and show the actual program to be followed and the profits resulting.

The matrix is "loaded" by starting with the sales demand for each product. Keeping in mind the yield relationship for each condition of operation, and using an index of relative profitability for each product, we use the mathematics of linear programming to determine the most profitable program and the process input that will produce it.

The matrix shows the entire program for a given sales demand. It indicates that we can sell all the naphthalene we can make from the process and that the profit will be $1,954.20 from this part of the yield. We will be forced to produce 4,650 gal. of drain oil more than we need. This excess will go to pitch tar mixture (PTM) and will result in a loss, or negative profit, of $46.50 for the excess amount.

By purchasing or using excess benzol naphthalene we can use up to 1,000 gal. per day excess capacity in the Naphthalene Department for the production of additional naphthalene and drain oil. This would result in $80 additional profit from naphthalene and $3.50 loss from drain oil. As shown in the lower right corner of the matrix the net profit for the program shown is $5,228.87 per day.

This is not the complete program and profit for this problem. We can purchase material, and make further profit utilizing some of the available capacity in #1 and #2 Tar Acid Departments to meet unfilled sales demand of 775, 164, 606, and 40 gal./day of phenol, ortho-creosol, meta-para-cresol, and xylenol respectively. The calculation for this is very simply carried out using a separate matrix and using indices for these refined tar acids which reflect the *purchase prices* of the raw materials rather than the production cost values used previously.

One of the most useful aspects of this approach is that it can be used as a before-the-fact tool in analyzing potential areas of improvement. For instance, in this case the calculations brought to light several opportunities for increasing profits through changes in approach or conditions. For instance, the still could be changed mechanically to enable it to operate under a different more profitable condition. Several hundred dollars per day could be realized by this change in condition.

LINEAR PROGRAMMING

How Does It Work?

The mathematical techniques of linear programming involve optimizing a linear function subject to constraints or restrictions. While not a cure-all, the method has much practical value.

A. ACRIVOS, University of California, Berkeley, Calif.†

In this short article, I shall give a brief, simplified explanation of linear programming, with the purpose of bringing its existence and usefulness to the attention of chemical engineers.

Let's examine the following hypothetical but typical situation. A drug manufacturer finds that a high demand exists for two drugs A and B. He, naturally, is intrigued by the high price at which both sell, and is therefore seriously considering the possibility of producing both.

However, he is confronted with this problem: All the raw materials for the synthesis of A and B are available in unlimited quantities and at a fixed price, except for two substances α and β, which can be procured at a fixed cost up to a certain amount, and thereafter not at all. Since both α and β are needed to synthesize the two drugs A and B, the manufacturer must decide how much of each drug to produce in order to maximize his profits.

Economic problems, such as this, and more involved ones, can best be solved by linear programming,* developed during World War II by the United States Air Force, and esspecially by G. B. Dantzig of the Rand Corporation.

Defining L. P.

Briefly, linear programming involves the problem of optimizing a linear function of a set of variables. The function is subject to a group of linear equations and/or inequalities called constraints or restrictions.

The linear function and constraints describe some practical situation. Maximum value for the linear function alone would be at infinity. The existence of a real maximum (or minimum) is due to the existence of the restrictive conditions.

In the drug manufacturing problem, the basic equations can be formulated as follows:

x_i = rate of production of the drug ($i = A$ or B).

a_{ji} = rate of consumption of the limited raw material j per unit rate of production of the drug i ($j = \alpha$ or β).

c_i = the net profit from selling one pound of the drug i.

s_j = the maximum available rate of supply of the limited raw material j.

r = the total profit per unit time.

The parameters a_{ji}, c_i and s_j must be known a priori, and the problem is to find the values of x_A and x_B which will maximize the linear profit function

$$r = c_A x_A + c_B x_B$$

provided, however, that the following four constrictive inequalities are satisfied:

$$x_A \gtrless 0$$
$$x_B \gtrless 0$$
$$a_{\alpha A}\, x_A + a_{\alpha B}\, x_B \gtrless s_\alpha$$
$$a_{\beta A}\, x_A + a_{\beta B}\, x_B \gtrless s_\beta$$

You might be tempted to solve this situation by trial and error and it's entirely possible for this simple problem.

Let's say

$$s_\alpha = 3, \quad s_\beta = 4$$
$$a_{\alpha A} = 1, \quad a_{\alpha B} = 1$$
$$a_{\beta A} = 2, \quad a_{\beta B} = 1$$
$$c_A = 3, \quad c_B = 2$$

Then

$$3x_A + 2x_B = r$$
$$x_A, x_B \gtrless 0$$
$$x_A + x_B \gtrless 3$$
$$2x_A + x_B \gtrless 4$$

Here is one equation with three unknowns and four restraints or inequalities.

The inequalities can be plotted as boundary lines enclosing a region in which the restraints hold true ($x_A + x_B = 3$, $2x_A + x_B = 4$). The intersection of these lines give the optimum values of x_A and x_B—in this case 1 and 2—for a maximum value of r.

In this example the optimum variables are at the intersection or corner of the permitted region. If there were three corners, the optimum value of r would be at one of the corners. We could solve the equations for each corner and pick the highest value for r. With more variables and more equations the situation becomes much more complex.

Fortunately linear programming (simplex method) using the algebra of matrices, permits going directly from one corner of the permissible region to another, showing the change of r for each shift. The calculation starts at one corner and compares an r value with neighboring corners. If any of the neighbors are "better" the calculation moves on to the next corner until optimum values are found for calculating profit.

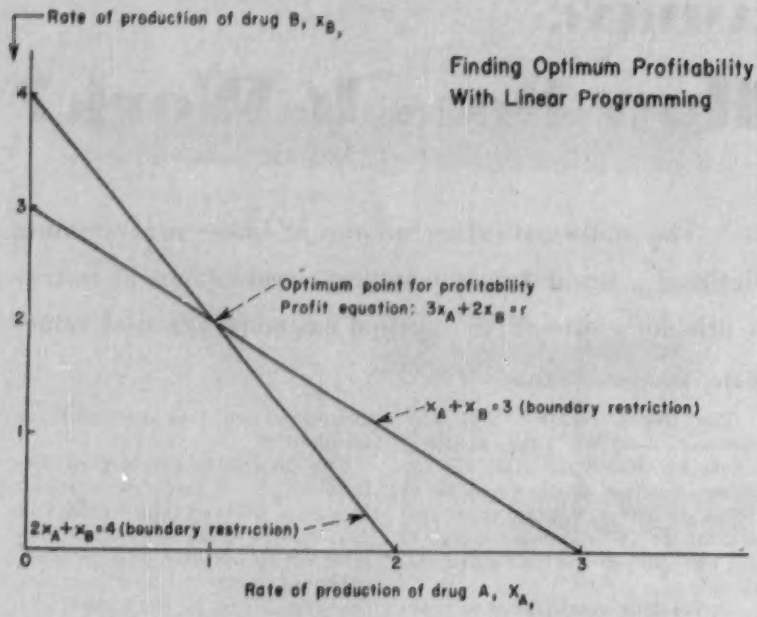
Must Be Linear

A very important assumption in this problem is linearity—the firm operates in an open market, and its production schedule does not have any effect either on the cost of the raw materials it purchases, or on the price of the products it sells. Of course, the terms raw materials and products should be taken in a very general sense and you should include capital, manpower, services, etc.

We see then, that linear program-

* A tool or technique of operations research—which has been defined as the application of the scientific method to the solution of business problems. Other techniques are waiting line theory, game theories and search theories.

† Meet your author on page 371.



ming has its obvious limitations and should not be thought of as a cure-all. However, it is a very powerful method.

Many Successes

Most chemical plants have their own specific conditions. Some are a hindrance, some have advantages. The more variables, and the more interlocking of these variables, the greater the problem and there is a greater chance for linear programs to improve over conventional methods. Multi-plant companies should find linear programming very helpful in considering plant capacity, production, storage, handling, shipping costs, distribution point capacity and costs all at one time.

Many companies—Shell Development, Esso, Merck, Monsanto, Koppers—are applying linear programming to their engineering and design problems. The number of companies using this technique is expected to increase very rapidly in the near future.

For a specific application of linear programming to a chemical process plant handling tar and tar products, see p. 211.

The literature[9] contains a report of a successful application of linear programming to petroleum refining. The problem is that of blending a number of organic compounds to produce premium and regular grades of automotive gasoline. We see here, immediately, the characteristics of a linear programming setup. In the very simplest case, we can suppose that the plant can produce two goods, premium and regular gasoline, while the scarce factors are some of the raw materials that go into the blending.

Of course more complicated situations can and have been worked out.

A chemical engineer is quite often faced with a situation where he is to convert a given plant, which, although originally designed to produce a product A, must now be used to produce B. The plant has of course a number of fixed units—distillation columns, cat-crackers, furnaces, and the like—and the capital to be spent in making this conversion is naturally limited. So, the chemical engineer has to come through with the best design, subject to the restrictions mentioned above.

Similarly, a farmer is faced with an analogous situation. His fixed factor is the size of the piece of land and its soil characteristics, and his problem is that of finding the right crops, the methods and the intensity of cultivation in order to maximize his income.

Another specific example is provided by a firm, let us say a large chemical company with a number of plants of various capacities producing a vinyl monomer in different parts of the U. S. The potential market for the monomer is widespread throughout the North American Continent. However, freight is a major element in the cost of monomer and the problem is to figure out how much monomer to ship from each plant to each customer.

Not a Cure-All

Of course, linear programming has its limitations and quite often the calculations which have to be performed, although very straightforward, are long and tedious. For a difficult problem, high speed digital computers should be employed. Computers are available capable of handling as many as 100 variables and 50 equations.

At the present time, interest in linear programming and its application to design problems is very strong and considerable effort is being spent by applied mathematicians in operations research groups to amplify the scope of programming methods in order to include non-linear problems.

Non-linear problems always arise when both the price of the products and the cost of the raw materials are not constant, but depend on the rates of production of the final goods and the rates of consumption of the raw materials.

Some very promising mathematical results have been devised to handle non-linear problems numerically with the aid of high-speed computing machines. The fact remains, however, that at this time, due to mathematical complexities, non-linear problems are much more difficult to work out compared to those that can be treated by linear programming.

References

1. Charnes, A., Cooper, W. W. and A. Henderson, "An Introduction to Linear Programming," John Wiley, New York, 1953.
2. Charnes, A., et al, *Econometrica*, **20**, April 1952.
3. Charnes, A., et al, *Jour. Oper. Research Soc. of Amer.*, **1**, May 1953.
4. Cooper, W. W. and A. Charnes, *Scientific American*, **191**, Aug. 1954, pp. 21-23.
5. Dorfman, R., "Application of Linear Programming to the Theory of the Time," Univ. of Calif. Press, Berkeley, Calif., 1951.
6. Dorfman, R., *American Economic Review*, Dec. 1953.
7. Eiseman, K., "Linear Programming," I.B.M. Pet. Conf., New York, 1954.
8. Morse, P. M., *Applied Mechanics Review*, Mar. 1954.
9. Symonds, G. H., *Ind. & Eng. Chem.*, **48**, 394, 1956.
10. Symonds, G. H., *Advanced Management*, **20**, 11-17, 1955.
11. Anon., *Business Week*, Mar. 12, 1955, p. 43.

Heat Transfer Fluids

Fluid	. . . For Normal Pilot Plant Operation				. . . For High Temperature Pilot Reactors					
	Dowtherm A	Dowtherm E	Aroclor 1248	S/V 600	Sodium	Na-K 56 wt. % Na	Mercury	Lead	Pb-Bi Eutectic	Salt Mixture $NaNO_2$, $NaNO_3$ & KNO_3
Working range, °F.	200–750*	300–500*	25–600	10–600	630–1,500	100–1,400	420–1,000	630–1,700	300–1,700	400–1,000
Melting point, °F.	53	—7	194 (Pour pt.)	10 (Pour pt.)	208	65	—37	622	257	290
Boiling point, °F.	496	352	645 (Extrap.)	650 (Extrap.)	1,616	1,518	675	3,170	3,038	.....
Latent heat, Btu./lb.	124–98	148–90	Not used as vapor	Not used as vapor	1,980	.....	127	.....	365	.....
Heat transfer coeff., h, Btu./hr/ft.²/°F.	45–90†	45–90†	10–90†	10–90†	6,400	3,500	5,700	4,100	3,700	900–2,600
Specific heat, Btu./lb./°F.	0.37–0.68	0.37–0.57	0.26–0.36	0.36–0.63	0.33–0.30	0.28	0.033	0.034	0.035	0.37

10 ft./sec.

* Condensing vapor. Latent temperature can be used when used as a liquid for cooling.
† Over-all coefficient, U. For Aroclor 1248 and S/V 600 depends on agitation of batch, if any, and the reactants being heated.

How to Pick Heat for Pilot Reactor

For general pilot plant use, organic heat transfer fluids fill most requirements. Here are common-sense answers to questions you face when selecting one best suited for your needs.

S. H. FRIEDMAN, Bechtel Associates, New York*

When you face the design and/or use of a pilot plant reactor you have a fairly wide choice of reactor heat-transfer fluids. However, unless you must satisfy exceptional high-temperature conditions, you can eliminate all but the usual industrial heat-transfer fluids. Then, you can make the important choice of the right fluid by striking a balance between end-use requirements and the properties of the available media.

Consider Temperature First

For flexible pilot-plant service a common reactor design is an agitated, jacketed 10-35 gal. vessel rated for 50 to 150 psig. and 600 F. max. Working temperatures above 600 F., although feasible from the equipment standpoint, are not available with common industrial heat-transfer fluids, other than Dowtherm A as a condensing vapor.

For the +600 F. range, choice centers around heat-transfer salts, sodium-potassium eutectics, mercury, direct firing and/or electric heating. Materials for +600 F. have excellent heat-transfer film coefficients, high boiling points and high maximum temperatures. But they do have drawbacks.

If you choose heat-transfer salts you require a high capital investment. The same is true for sodium-potassium eutectics and, in addition, design of the heating system is a delicate proposition.

These two media find most advantageous use on continuous service. Inherently, many pilot reactors are batch units, even when run continuously. For this reason, neither heat-transfer salts nor sodium-potassium eutectics would be chosen unless they were being considered seriously for the full-size plant reactor.

Mercury has the disadvantage of being poisonous, expensive and difficult to contain within the system. It would not be used unless the particular reaction required a high heat-transfer rate.

Pilot reactors usually are not direct fired because of cumbersome equipment, poor control, thermal stresses, high skin temperature and low thermal efficiency.

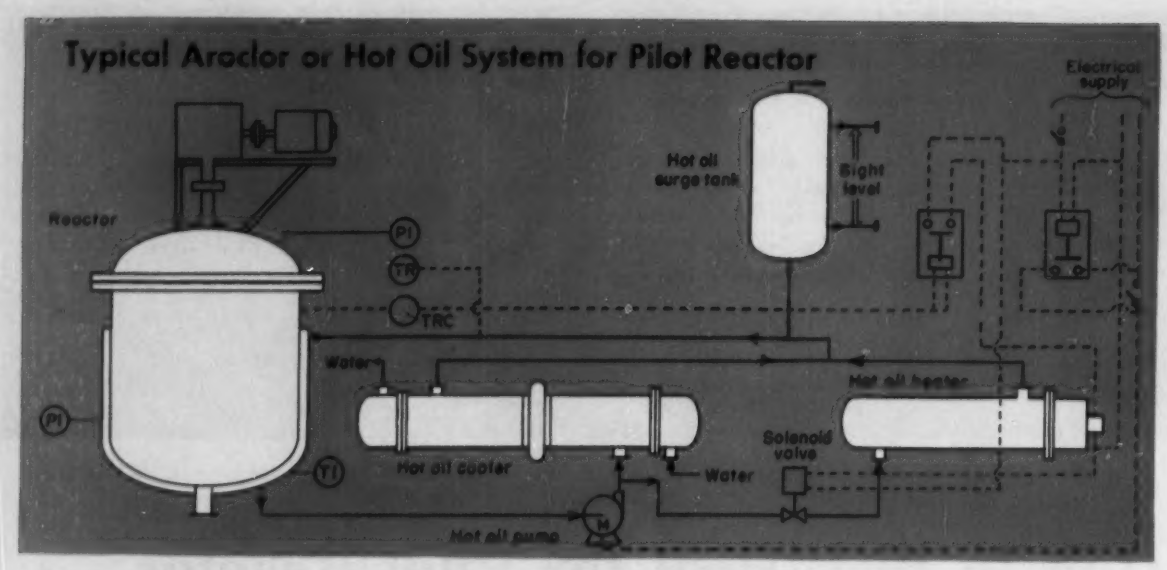
Electric heating may be expensive to operate and can produce local overheating if not properly designed. However, it frequently is a good choice for heating the transfer fluid.

Many times electric heating is chosen for pilot reactors because it is convenient. If the current-carrying capacity of the power line is sufficiently high the unit may be simply plugged in, providing the usual circuit breakers are installed. Electric heaters can be controlled accurately, can produce heat exactly where it is needed and have no combustion products.

If, in addition to heating, jacket cooling is required then electric heating is ruled out. However, this cooling problem can be bypassed by placing cooling coils inside the vessel. Shortcomings of this method are difficulty in keeping coils clean, complexity and lack of room in the reactor, and poor geometric similitude to a large-scale reactor.

When maximum design temperature is 600 F. or less, choice of heat transfer fluids is reduced to: steam, heat transfer oil, Dowtherm A or E and Aroclor.

* Meet your author on page 273.



Plots of vapor pressure vs. temperature for these media show at 600 F. that both Aroclor and S/V 600 are well below their boiling points, while Dowtherm A has a saturation pressure of 46 psia. and steam 1,540 psia.

Steam almost always is eliminated for operations to 600 F. because of its extremely high saturation pressure (1,540 psia. at 600 F.). Even if such an improbable pressure were available in the laboratory, vessel and jacket wall thicknesses would be so heavy as to make the reactor awkward and prohibitively expensive.

Thus, the high saturation pressure of steam at 600 F. and higher reduces the number of available heat transfer media to Dowtherm, Aroclor and heat transfer oil.

How They Differ

Dowtherms A and E as well as Aroclor 1248, the Aroclor adaptable to this temperature range, are all aromatics of definite and similar chemical formula. Hence they have many like properties.

The major difference is that Dowtherm can be used in the vapor and liquid state. Aroclor 1248 (Monsanto), on the other hand, has a vapor pressure of only 500 mm. Hg abs. at 600 F.

In this discussion, Dowtherm E will not be included in the comparison with Aroclor and S/V 600. First offered in 1944, this clear colorless or light straw-colored liquid is a comparatively new entry into industrial heating.

Dowtherm E has an atmospheric boiling point of 352 F., was developed to fill the gap between steam at 85 psi. and Dowtherm A at atmospheric pressure (496 F.). It is a specially treated grade of *o*-dichlorobenzene recommended for use only at temperatures below 500 F. where its vapor pressure is 72 psig.

If the range limitation of 500 F. is acceptable, Dowtherm E has the advantageous property of freezing at −7 F., whereas Dowtherm A freezes at 53.2 F. In the latter case pipe lines and equipment should be steam traced if it is likely that ambient temperature will approach 53.2 F.

The heat transfer oil discussed here is Socony-Mobil Oil's S/V 600, an aromatic mineral oil that is exceptionally resistant to thermal cracking.

Conventional mineral oils often are used because they are inexpensive and readily available. Such paraffinic cylinder oils with viscosities running about 200 SSU. at 210 F. are limited to 450 F. in an open system and 600 F. in closed systems.

In contrast to the Socony S/V 600, conventional oils crack under heat to produce volatile fractions and heavier residues which flow slowly and decrease heat transfer from the heating elements to the oil. Thermal efficiency is reduced and electrical elements or tubes burn out.

Factors Affecting Choice

The decision as to use of Dowtherm, Aroclor or S/V 600 for heating a particular pilot reactor depends mainly on:

- Is condensing vapor required?
- Will heat transfer liquid be used both for heating and cooling?
- What is relative capital investment?
- Does it have necessary physical characteristics?
- Can it satisfy critical operating need?

Condensing Vapor—Dowtherm with a boiling point at 496 F. is the only one of the three heat-transfer fluids that boils below 600 F. Under pressure up to 145 psig., Dowtherm could reach a safe temperature of 750 F. This extra high-temperature advantage is offset by the need to have a boiler to handle this pressure.

If it were desired to use Dowtherm below its boiling point (liquid-phase heat transfer), the maximum temperature available would be 496 F. Even if Dowtherm were used as a condensing vapor, its latent heat on a weight basis is only approximately 12% the latent heat of steam.

Heating and Cooling—At 100 F., viscosities of the media in centipoises are: S/V 600, 58; Aroclor,

86; Dowtherm, 3. Below this temperature, the viscosity of S/V 600 and Aroclor will cause high power costs for pumping.

Though Dowtherm has a viscosity of only 4.8 at 55 F., it freezes at 53.2 F. Thus, Dowtherm lines on cooling service would have to be steam traced to avoid clogging annoyances. On freezing, Dowtherm contracts and will not burst pipes.

Capital Investment—Used as a vapor, Dowtherm would represent the highest capital investment of the three fluids, because of the higher pressure. A rough price would be $5,000 for a 100,000 Btu. per hr. vaporizer designed for 600 F. with necessary equipment and controls, installed.

A rough price for installed Aroclor equipment designed for 100,000 Btu. per hr. at 600 F. would be $2,500. The installed cost for S/V 600 under similar design conditions probably would be slightly less.

Physical Data—The more important physical data are compared in the accompanying Table, p. 220. These include heat capacity, density, flash point, fire point, pour point, boiling point, chemical composition, viscosity, form and color.

Critical Traits—Certain traits of the heat transfer fluids are critical from the standpoint of use in an operating unit, according to the process and operating conditions. These include toxicity, corrosion, heat stability and fire hazard. They will be discussed in turn below.

Corrosion

S/V 600—Copper and its alloys should not be used. They are powerful catalysts for this material, promoting oxidation and sludging. Exceptions may be made for small parts such as valves and bushings in systems or parts of systems operating at low temperatures. Iron or carbon steel are preferred for the entire unit.

Aroclor—There is practically no corrosive effect on most metals and plastic materials of construction within the normal range of temperatures.

Dowtherm—A good grade of iron or carbon steel is preferred for the entire system. Local or national boiler-code regulations must be met if Dowtherm is used as a condensing vapor.

Toxicity

S/V 600—No toxicological or dermatological effects are noted. Effects may be considered the same as for petroleum or mineral oils.

Aroclor—It is a very stable, unreactive liquid. If the material is spilled on the skin, there are no noticeable ill effects. However, it is well to wash the skin with soap and water after contact. A skin burn should be treated as for normal hot oils.

Vapors emitted by hot Aroclor are injurious to the liver on prolonged exposure and, therefore, should not be inhaled. In commercial installations, a closed system should be used.

Drinker,[1] indicates 0.5 mg. of Aroclor 1248 per cu. m. of air is the maximum safe amount in workrooms.

Dowtherm—There is no appreciable hazard to health when Dowtherm is used as a heat-transfer medium. Toxicological investigation has failed to demonstrate a significant degree of toxicity.

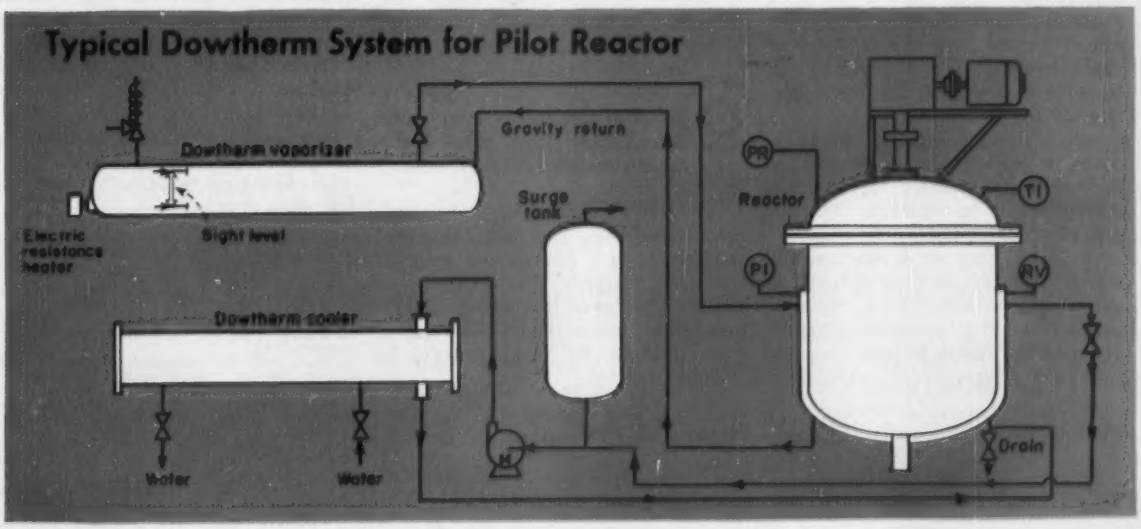
The vapor or fumes are extremely disagreeable even at quite low concentration. This property is sufficient to prevent exposures that might conceivably be injurious. Since its development in 1932, no known illness has resulted from testing or using Dowtherm.

Heat Stability

S/V 600—Recommended for use up to 600 F. in sealed circulation systems where the temperature during shutdown will not be below 10 F. Forced circulation must be used because convection circulation is not sufficiently rapid to avoid overheating and rapid deterioration of the oil.

Aroclor—In order to establish a maximum practical operating temperature, the stability of the material was noted when heated to elevated temperatures in the presence of iron. Samples heated for 30 hr. indicate that decomposition at 600 F. is very low.

Dowtherm—Although it is a very stable organic material, severe



Physical Properties of Organic Heat-Transfer Fluids

		S/V 600	Aroclor 1248	Dowtherm A
Chemical Composition		Aromatic petroleum oils	Chlorinated diphenyls	Eutectic, 26.5% diphenyl, 73.5% diphenyl oxide
Form & color			Yellow tinted mobile oil	Light-straw-colored oil
Normal boiling point, °F.		650	645	496
Heat capacity, Btu./lb./°F.	100 F.	0.36	0.30	0.40
	130	0.41	0.31	0.41
	210	0.44	0.33	0.45
	300	0.49	0.36	0.50
Density, gm./cc.	100 F.	0.962	1.42	1.04
	130	0.957	1.41	1.03
	210	0.932	1.37	1.00
	300	0.900	1.32	0.957
	400	0.868	1.27	0.904
Flash point, °F.		360	379–384	255
Fire point, °F.			About 700	275
Pour point, °F.		10	19.4	53.2
Viscosity, centipoises	55 F.	330	....	4.8
	100	58	86	2.95
	130	26	20	2.0
	210	5.4	4.2	1.0
	400	1.0	0.92	0.4

operating conditions can decompose Dowtherm. In a carefully designed system it may be run up to 750 F. By careful design is meant avoidance of localized overheating and places where liquid can stagnate. Below 650 F., Dowtherm will not decompose appreciably in properly designed and operated equipment.

When Dowtherm is first heated it rapidly turns dark and opaque. This is due to exceedingly fine particles of mill scale from the pipewalls, decomposed cutting oil from the threads and carbon particles from decomposition of a minor impurity in the Dowtherm. None of these suspended fine particles interferes in any way with the operation of the systems.

At higher operating temperatures, a high-molecular-weight decomposition product is formed which stays in solution. It does not affect operation.

A third type of decomposition, which produces carbon and hydrogen, must be avoided. A layer of carbon forming on the heat transfer wall can increase wall temperature and accelerate decomposition.

Fire Hazard

S/V 600—Considering that proper design calls for a closed system when using this oil, fire hazard is reduced considerably. Because S/V 600 has a rather high flash point and high resistance to thermal cracking, it is safer than conventional mineral oils.

Aroclor—The non-flammability is illustrated best by an actual operating experience. On startup, an operator failed to start circulation when the gas heater was lighted. The coil overheated, ruptured a weld and poured Aroclor into the red-hot fire chamber in contact with the flame.

Dense smoke arose from the heater but there was no external fire. When the gas flame was cut off, emission of smoke stopped.

Dowtherm—High flash point for this material minimizes the chance for fire. Vapors from small leaks cool rapidly to drop below the flash point.

Only two fires outside the vaporizer have been reported. One occurred when a gasket was omitted between flanges. The other when a crane dropped a load on a pipe carrying Dowtherm and the vapor was ignited by the torch of a welder nearby.

Points to Remember

None of these heat transfer fluids is in itself a panacea for heat transfer applications over the stated temperature range. Dowtherm has a maximum temperature limit of 496 F. as a liquid. In the vapor phase, temperatures up to 750 F. can be reached but auxiliary equipment must be constructed to withstand pressure.

Aroclor can be used as a liquid to 600 F. but leakage from the piping system could have injurious effects on the operators. On the other hand Aroclor is not known to support combustion while S/V 600 can burn since it is a mineral oil.

The final choice is made best by deciding what reactions are to be carried out in the reactor and the real maximum temperature required. The correct heat-transfer agent is selected after a thorough appraisal of all the conditions in a particular system.

None of these fluids is ideal under all conditions. As shown, they all have drawbacks. It is up to the engineers and designers to decide which factors are most important for the particular system.

Reactor Setup

A typical equipment setup is shown, p. 218, for Aroclor or S/V 600, required either to heat or cool. The electric relays and solenoid valve provide overheating protection for the batch and surety that the oil is pumped when the electric heater is on.

A similar equipment setup for Dowtherm is shown also, p. 219.

Complete automation of a pilot plant reactor unit would be impractical. Usually, these are batch reactors operated either by highly skilled technicians or engineers.

Exact control of a pilot reaction requires rapid and frequent changes in process variables. Such changes are administered best by the operator who makes his decisions based on the data as they are collected.

REFERENCES

1. Drinker, C. K., *J. Ind. Hyg. Toxicol.* 21, 155 (1939).
2. Meade McArdle, Garrett, L. C. and Benignus, P. G., *Ind. Eng. Chem.*, 41, 1341, (1949).
3. Monsanto Technical Bulletin P-115, "The Aroclors," Monsanto Chemical Co., St. Louis, Mo., (1955).
4. "Eclipse Dowtherm Vaporizers and Heaters," Eclipse Fuel Engineering Co., Rockford, Ill., (1953).
5. Technical Bulletin, "Aromatic Heat Transfer Oils," Socony-Mobil Oil Co., New York, (1954).
6. "Dowtherm Handbook," The Dow Chemical Co., Midland, Mich., (1954).

Chemical Engineering Fundamentals

Catalytic Reactor Design Problems—II

How much catalyst do we need in an adiabatic reactor to give the right conversion and production? Here's the step-by-step solution.

T. E. Corrigan and W. C. Mills, Olin Mathieson Chemical Corp., Brandenburg, Ky.

OUR basic process design problem in the design of a heterogeneous reactor is to determine how much catalyst we need and what size reactor we need for the desired production capacity and conversion.

In the case of a fixed-bed reactor, the amount of catalyst and the reactor size are directly related. In a fluidized-bed reactor, the relation is not so direct because the bed density changes with the gas velocity.

When You Operate Adiabatically

In this series of three installments on catalytic reactor design problems (started last month, *Chem. Eng.*, July 1956, p. 201) we plan to show how to calculate the reactor size and amount of catalyst needed for fixed-bed reactors. This month we will consider adiabatic reactors.

Nomenclature (Consistent Units)

A, B	Reactants
C_p	Heat capacity at constant pressure
F	Feed rate
k_1, etc.	Rate constant, forward reaction
K_A, etc.	Adsorption equilibrium constant
p_A, etc.	Equilibrium partial pressure of adsorbent gas
r	Reaction rate
R, S	Products
t	Temperature, ° F.
T	Absolute temperature
W	Mass of catalyst
x	Degree of conversion
Δ	Finite change in a property

There are three basic modes of operation for chemical reactors:

- Isothermal. There is enough heat transfer into or out of the reactor to maintain a constant temperature.
- Adiabatic. There is no heat transfer into or out of the reactor.
- Nonisothermal, nonadiabatic. There is some heat transfer into or out of the reactor, but it is not equal to the heat of reaction.

Most commercial chemical reactors are operated as nonisothermal, nonadiabatic reactors.

The isothermal case is the easiest for us to calculate because at any stage in the reaction the temperature is the same, therefore there is no variation in the value of the rate constant, k, or the adsorption equilibrium constant, K_A, etc. We can size an isothermal reactor without resorting to trial-and-error calculations.

In an adiabatic reaction the temperature changes constantly as the reaction proceeds and, therefore, the rate and adsorption constants change continually. However, we can use a heat balance to relate temperature to the degree of conversion. Since the values of the constants will already be related to temperature, they can be estimated for any degree of conversion. Thus—although this case is slightly more complicated than the isothermal case—there is no need for a trial-and-error solution.

Design Problem: Adiabatic Reaction

Let's consider that the same reaction that we discussed last month (*Chem. Eng.*, July 1956, p.

Here's Your Guide to the Series on Catalytic Reactor Design Problems

Last Month	In This Issue	Next Month
Isothermal reactor. Heat transfer at reactor holds the temperature constant.	Adiabatic reactor. There is no heat transfer into or out of the reactor.	Nonisothermal, nonadiabatic reactor. By far the most important industrial case.

Procedure to Find
Lb. of Catalyst/Lb. of Feed
Adiabatic System

- Get values for reaction rate constants over temperature range of the reaction.
- Obtain heat of reaction data over the entire temperature range.
- Obtain heat capacities over the entire temperature range.
- Calculate a working plot of degree of conversion vs. temperature
- Calculate and tabulate values of reaction rate for various degrees of conversion.
- Plot the reciprocal of the rate of reaction against the degree of conversion.
- Integrate for total area under the curve. This is the desired value of W/F.

201) as taking place in an isothermal reactor is now taking place in an adiabatic reactor. The reaction equation is still the same:

$$A + B \rightleftarrows R + S$$

And the empirical rate equation is still given in the following form:

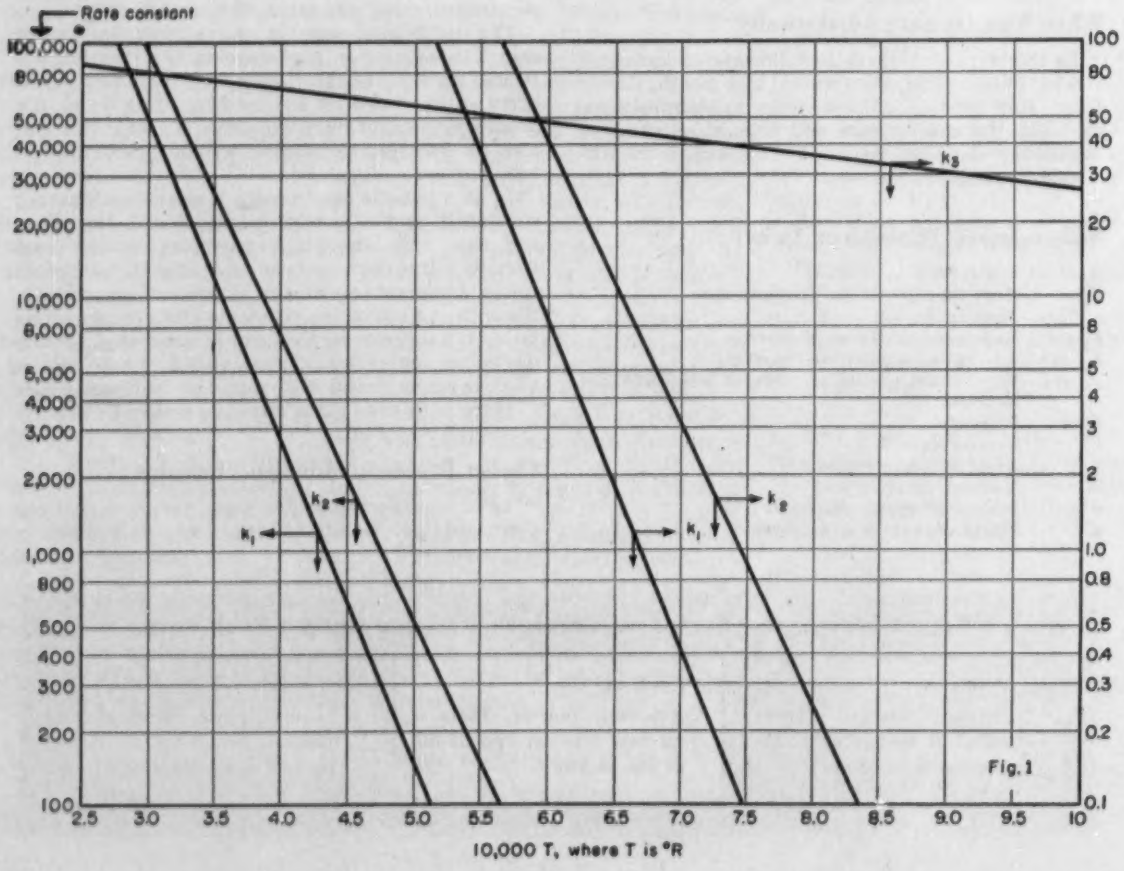
$$r = \frac{k_1 p_A p_B}{1 + k_2 p_A + k_3 p_R}$$

If the feed to the reactor is preheated to a temperature of 1,800 F., how much catalyst will be required to give 95% conversion using a stoichiometric feed ratio and no recycle? The desired production rate is 1,000 lb. of R per hr.

The reactor is to be operated at a pressure of 2.0 atm. and there is a negligible pressure drop through the reactor.

Before we go on to the solution of this specific problem, we want to repeat that in presenting these problems we will emphasize only the kinetic aspects. We don't want to confuse the issue with complicated thermochemical or thermodynamic calculations. We plan to avoid these calculations by using many simplifying assumptions such as constant heat capacities of gases (or linear variation of heat capacity with temperature).

Get your k values here.



We will also use hypothetical chemical reactions based on hypothetical reactants and products.

The General Procedure

Here is the general procedure to use in solving this type of reactor design problem:

1. Evaluate or look up the values of the rate constants k_1, k_2, k_3, etc. over the temperature range that is being considered in the problem.
2. Obtain heat of reaction data over the entire temperature range.
3. Obtain heat capacities (at constant pressure) over the entire temperature range.
4. Use the heat of reaction and heat capacity data to calculate and tabulate values for a working plot of degree of conversion, x, vs. temperature, t. This will require calculation of values of p_A, p_B and p_S for various values of x between zero and 0.95 using a material balance.
5. Calculate and tabulate the value of reaction rate, r, at each value of conversion, x. Use value of the rate constant, k, at the temperature indicated for each value of conversion on the x vs. t working curve.
6. Plot $1/r$ vs. x. For convenience in graphical integration, several expanded plots may be helpful.
7. Integrate for the total area under the curve of $1/r$ vs. x from $x = 0$ to $x = 0.95$ in order to evaluate this equation:

$$\frac{W}{F} = \int_0^{0.95} \frac{x\,dx}{r}$$

This gives the value of W/F. Since F is given, we can arrive at the value of W.

Some Additional Data

We will need some other data to solve this problem. First, here are the molecular weights of the reactants and products. Molecular weight of $A = 80$; of $B = 20$; of $R = 40$; and of $S = 60$.

Assume that the variation of the rate constants with temperature can be represented by logarithmic plots against the reciprocal of the absolute temperature. Fig. 1 on p. 222 is such a plot.

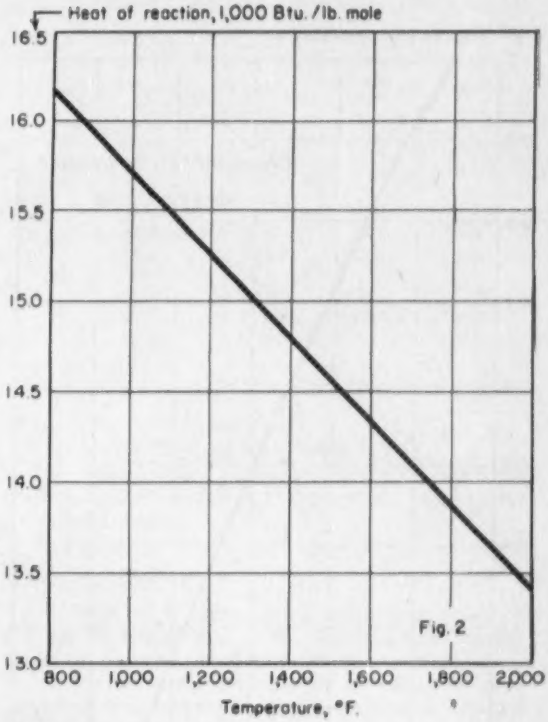
Next, we'll need a relationship for the variation of heat of reaction with temperature. Fig. 2 gives us this. It plots heat of reaction in Btu./lb. mole against temperature in ° F.

To complete our heat and material balances we will need also some heat capacity data for all the products and reactants. We'll find these in Fig. 3 where heat capacity in Btu./lb. mole—° F. is plotted against temperature in ° F.

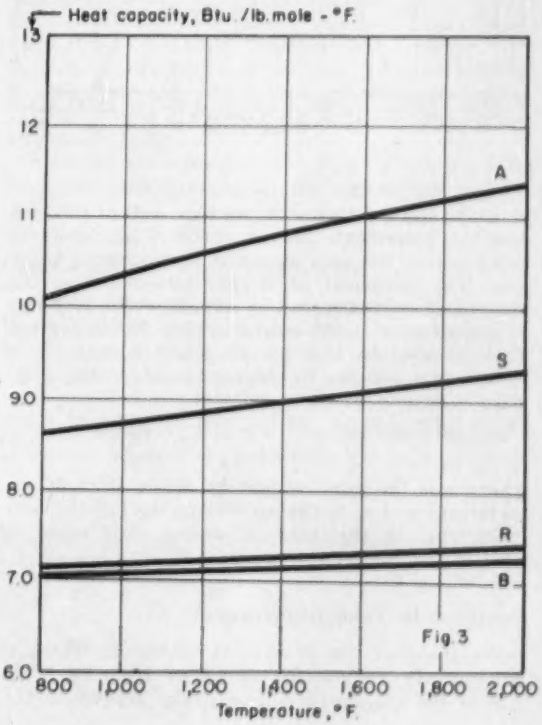
Conversion and Temperature

We are now armed with enough information to begin calculating the effect of conversion on temperature in the reactor. Since we are considering an adiabatic system, there is no heat transfer into or out of the reactor and the heat of reaction required to keep the reaction going will be obtained by lowering the temperature of the system—in effect, taking heat away from the preheated feed to the reactor.

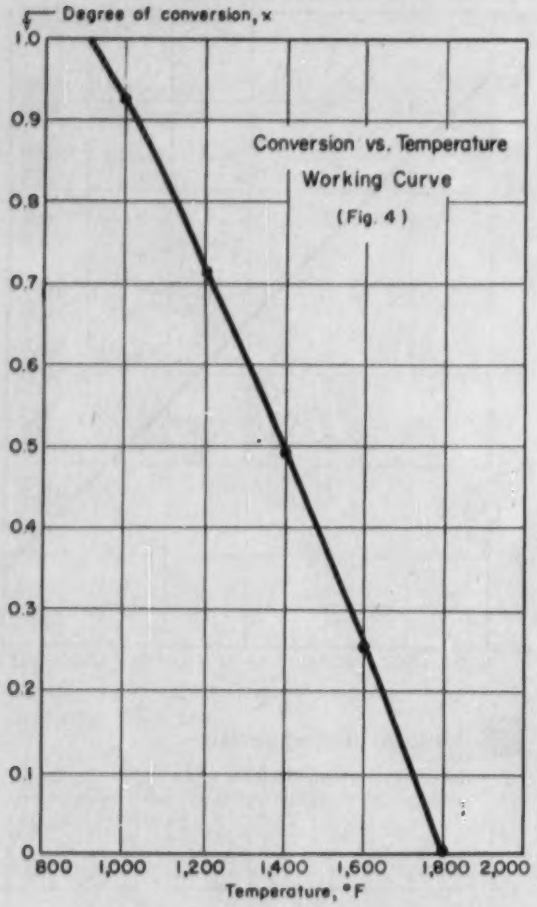
Obtain heat of reaction data over the entire temperature range.



Obtain heat capacities.



Construct a working plot of conversion vs. temperature based on heat and material balances.



First we assume an incremental drop in temperature and determine the average heat of reaction over this increment. Now, for each of the reactants and products the area under its heat capacity curve over this increment of temperature indicates the amount of heat absorbed in adjusting the enthalpy of the material to the new conditions in the system. This is based on Btu. absorbed per lb. mole.

We can determine the degree of conversion, x, by the following heat balance:

$$x_1 \text{ (Heat of reaction)} = (1 - 0.5x)\ (C_p\ \Delta t \text{ Reactants}) + 0.5x(C_p\ \Delta t \text{ Products})$$

where x is the total conversion at the start of the increment and x_1 is the conversion during the first increment. In this case, of course, x is equal to zero.

Continue to Take Increments

We continue the process of taking incremental temperature ranges for our heat balances. The size of the increment will naturally depend on the accuracy required and the variation of heat capacity and heat of reaction with temperature.

Use the rate equation to calculate and . . .

Conversion x	$1 - x$	$p_A p_B$	Temp., °F	k_1
0.1	0.9	0.81	1,720	760
0.2	0.8	0.64	1,640	230
0.3	0.7	0.49	1,560	160
0.4	0.6	0.36	1,475	90
0.5	0.5	0.25	1,390	42
0.6	0.4	0.16	1,300	20.7
0.7	0.3	0.09	1,210	7.80
0.8	0.2	0.04	1,120	2.90
0.9	0.1	0.01	1,020	0.83
0.92	0.08	0.0064	1,005	0.65
0.94	0.06	0.0036	985	0.51
0.95	0.05	0.0025	970	0.40

For our next incremental range we use this heat balance:

$$x_2 \text{ (Heat of reaction)} = (1 - x_1 - 0.5x_2)\ (C_p\ \Delta t \text{ Reactants}) + (x_1 + 0.5x_2)\ (C_p\ \Delta t \text{ Products})$$

Here x_2 is the conversion during this second increment and x_1 is the total conversion up to the beginning of the second increment.

By taking a sufficient number of increments we can arrive at corresponding values of temperature and conversion until we reach the desired degree of conversion in the reactor.

If we use as our basis one lb. mole each of reactants A and B, preheated to 1,800 F., we can work out the two tables below.

Temperature Range, °F.	Area Under Heat Capacity Curves, Btu. A	B	R	S
1,800–1,600	2,226	1,438	1,460	1,832
1,600–1,400	2,186	1,428	1,448	1,806
1,400–1,200	2,144	1,420	1,440	1,780
1,200–1,000	2,100	1,414	1,432	1,760

Temperature Range, °F.	Average Heat of Reaction, Btu.	Conversion, x
1,800–1,600	14,100	0.256
1,600–1,400	14,575	0.495
1,400–1,200	15,050	0.718
1,200–1,000	15,540	0.927

Solve for Partial Pressures

Our next job is to evaluate p_A, p_B, p_R and p_S as functions of conversion, x, where x is equal to lb. moles converted per lb. mole in the feed. Then,

Lb. moles of A left = $1 - x$
Lb. moles of B left = $1 - x$
Lb. moles of R formed = x

Component	Lb. Moles	Mole Fraction	Partial Pressure at 2.0 Atm.
A	$1 - x$	$(1 - x)/2$	$1 - x$
B	$1 - x$	$(1 - x)/2$	$1 - x$
R	x	$x/2$	x
S	x	$x/2$	x

. . . tabulate values of r at each value of x.

k_2	k_3	$k_1p_Ap_B$	k_2p_A	p_B	k_3p_B	$1 + k_2p_A + k_3p_B$	r	$1/r$	Conversion, x
2,300	64.0	616	2,070	0.1	6.40	2,077	0.296	3.37	0.1
1,000	60.0	147.3	800	0.2	12.00	813	0.1811	5.52	0.2
580	58.0	78.3	406	0.3	17.40	424.4	0.1845	5.43	0.3
340	56.5	32.4	204	0.4	22.6	227.6	0.1425	7.02	0.4
180	54.0	10.5	90	0.5	27.0	118.0	0.0890	11.24	0.5
100	52.0	3.31	40	0.6	31.2	72.2	0.0459	21.8	0.6
41.8	49.0	0.702	12.5	0.7	34.3	4.78	0.0147	68.1	0.7
18.0	46.6	0.1160	3.60	0.8	37.28	41.88	0.0028	361	0.8
6.25	42.8	0.00830	0.625	0.9	38.50	40.12	0.00020	4,960	0.9
5.00	41.9	0.00416	0.400	0.92	38.50	39.90	0.000104	9,580	0.92
4.05	41.0	0.00184	0.243	0.94	38.50	39.74	0.0000464	21,600	0.94
3.30	40.2	0.00100	0.165	0.95	38.50	39.36	0.0000254	39,360	0.95

Then Get the Rate

When we have arrived at the partial pressure values, we can calculate the values of reaction rate, r, and values of $1/r$ for various degrees of conversion, x.

For these calculations we substitute into the reaction rate equation that we have been given previously:

$$r = \frac{k_1p_Ap_B}{1 + k_2p_A + k_3p_B}$$

The calculations are worked out in the table directly above.

Plot Values, Integrate for Area

Next, we plot the tabular values of $1/r$ against values of x. Because of the sharp decrease in reaction rate as we go above 70% conversion, it will be convenient to use a two-part plot. First we'll plot $1/r$ vs. x up to 70% conversion (Fig. 5). Then we'll use another plot with a compressed $1/r$ scale from 70 to 95% conversion (Fig. 6).

In any event we arrive at the total area under the curve.

$$\text{Total Area} = \int_0^{0.95} dx/r$$

$$\text{Total Area} = 928$$

How Many Pounds of Catalyst?

The total area under the curve tells us that we need 928 lb. of catalyst per lb. mole of A in the feed.

Our desired production capacity is 1,000 lb. of R/hr. With a molecular weight of 40, this would be 25 lb. moles of R/hr. The lb. moles of A required would be:

$$25 \text{ lb. moles of } R/0.95 \text{ conversion} = 26.3$$

And the weight of catalyst required would be:

$$W = 928(26.3) = 24{,}400 \text{ lb.}$$

The specific bulk density of the catalyst might be of the order of magnitude of 1.25. Then the volume of catalyst required would be:

$$24{,}400/(1.25)\ (62.4) = 313 \text{ cu. ft.}$$

The task of sizing the reactor remains. We must allow a catalyst space of 313 cu. ft. in our tubular fixed-bed reactor.

Sizing the Reactor

Let's see what size reactor a catalyst space of 313 cu. ft. might lead us to. Assume that the reactor is to consist of parallel tubes 40-ft. long (I.P.S.) Cross-sectional area of Schedule 40 pipe is 12.7 sq. in. or 0.0883 sq. ft. The volume of catalyst in each tube would be $40(0.0883) = 3.53$ cu. ft.

Therefore, the number of tubes required would be 313/3.53 or 89 tubes. To find the size of the reactor shell we will take the nearest standard tube layout. Referring to p. 842 of "Process Heat Transfer," by D. Q. Kern, we find that for 1-in. tubes on 1.25-in. centers arranged with a standard triangular pitch (125% of tube diameter) the shell diameter would be equal to 15.25 in.

Since we are using 4-in. std. pipe (which is 4.5-in. O. D.) the required I. D. of the reactor would be 68.6 in.

Compare This With Backmixing

If we were to operate the reactor with the catalyst in one single bed of large diameter and shallow height, there would be considerable backmixing. Let's calculate the amount of catalyst that would be required if the reaction were to take place with 100% backmixing. We can use the following equation:

$$W/F = \int_0^{x_f} dx/r_f = x_f/r_f$$

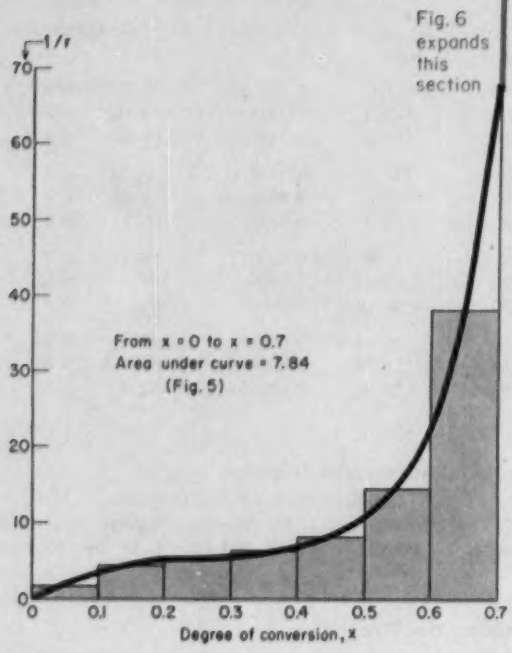
where x_f and r_f are the values of x and r at the desired conversion of 95% ($x_f = 0.95$).

$$r_f = \frac{k_1p_Ap_B}{1 + k_2p_A + k_3p_B}$$

At $x = 0.95$,

$$p_A = p_B = 0.05$$
$$p_R = 0.95$$

6 **Plot $1/r$ vs. x.**



7 **Integrate for total area.**

ANSWER: $W/F = 928$

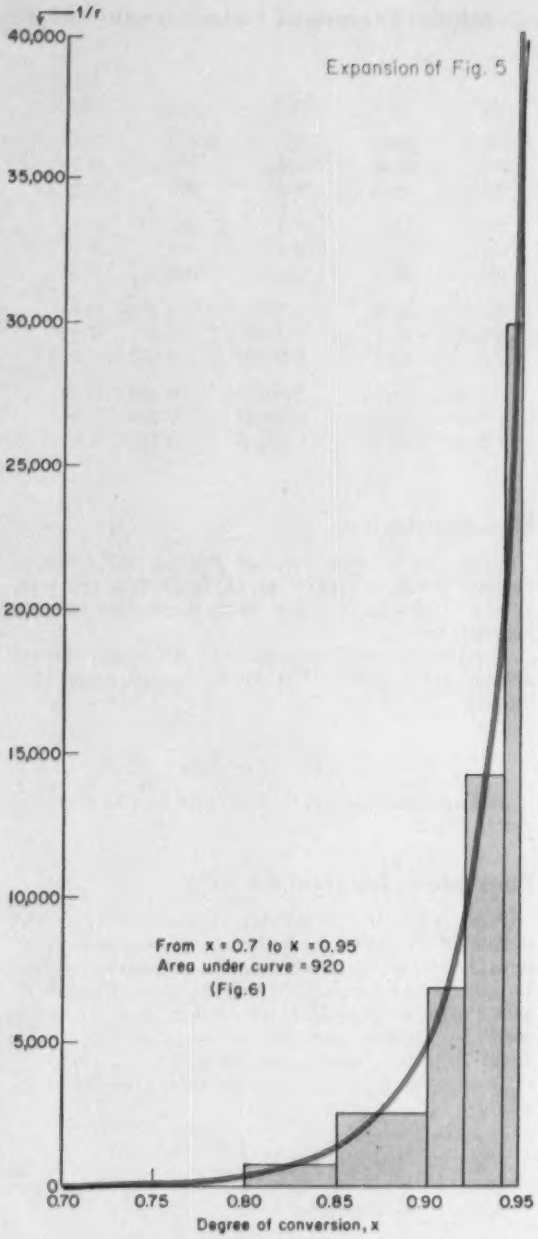
(*Continued from p. 225*)

$$k_1 p_A p_B = 0.0001$$
$$k_2 p_A = 0.165$$
$$k_3 p_B = 38.1$$
$$1 + k_1 p_A + k_3 p_B = 39.27$$
$$r_f = 2.54 \times 10^{-5}$$
$$1/r_f = 39{,}270$$
$$W/F = x_f/r_f = 0.95(39{,}200)$$
$$W/F = 37{,}300 \text{ lb. of catalyst per lb. mole of } A \text{ fed to the reactor}$$

Therefore, the weight of catalyst would be:

$$(37{,}300)\ (26.3) = 982{,}000 \text{ lb.}$$

This is over 40 times the catalyst that we needed for the longitudinal reactor. Certainly, backmixing in the reactor should be avoided.



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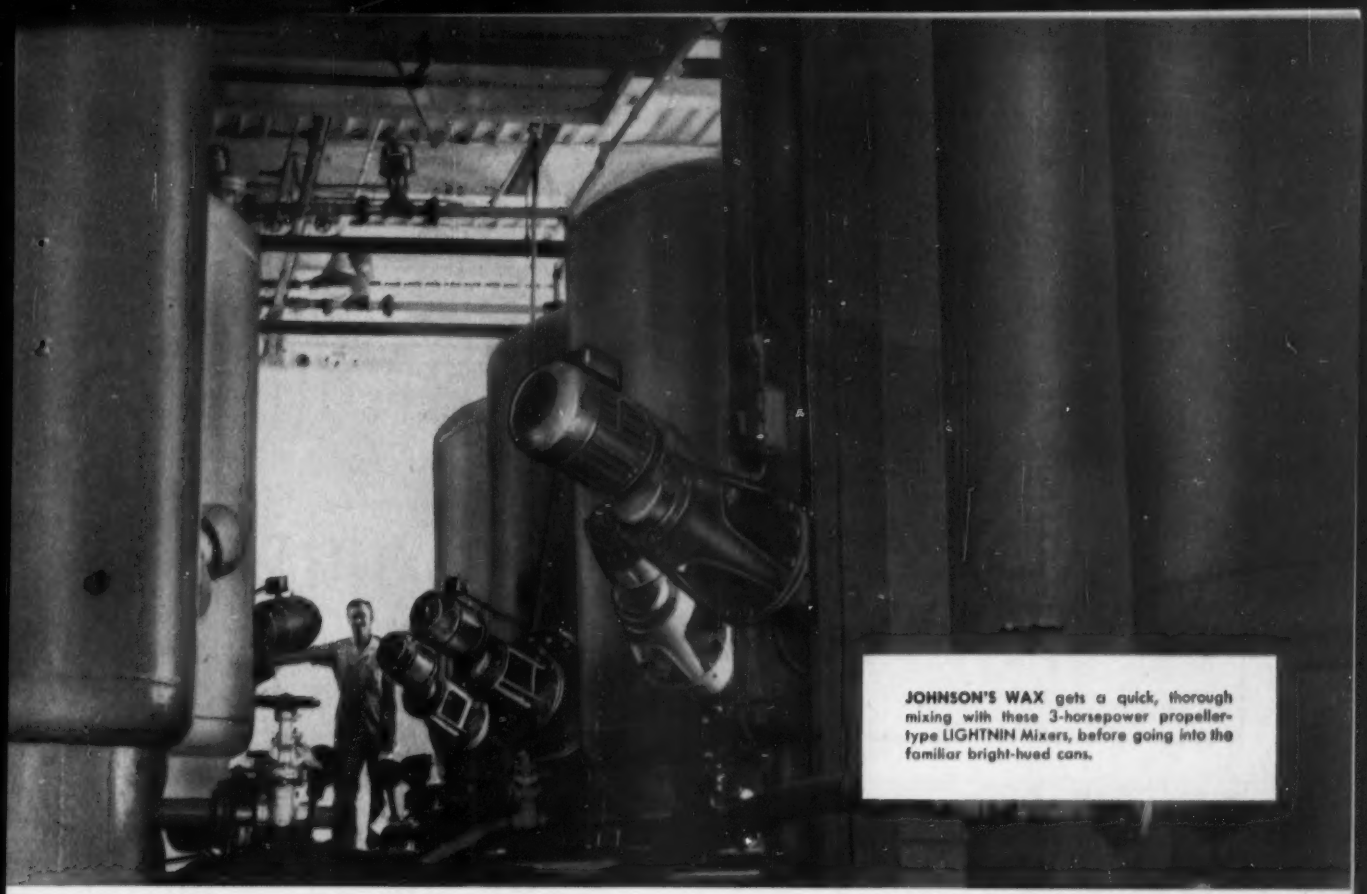

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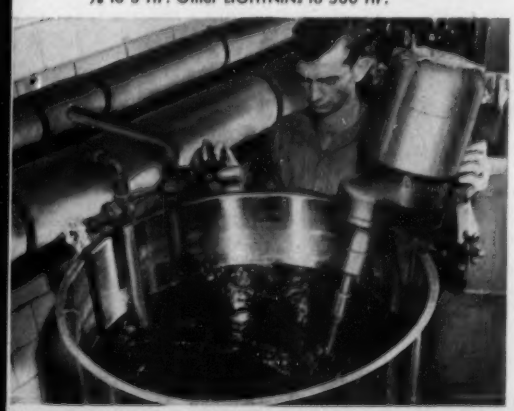

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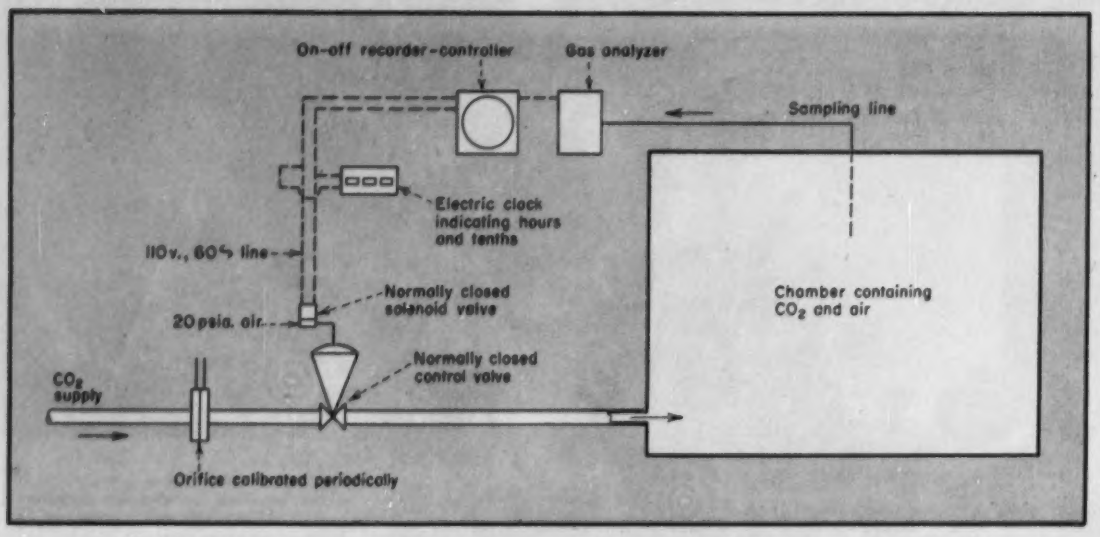

★ **Winner of May Contest**

Electric Timer Used to Totalize Flow of Process Gas

Where intermittent flow is permissible, recording flow time through an orifice is an effective method of totalizing.

Herbert Borsvold

Senior Process Engineer, Texfoam Div., B. F. Goodrich Sponge Products Division, Shelton, Conn.

We have a chamber in which we need a controlled percentage of carbon dioxide. A continuous analyzer-controller does the control job nicely. However, we want also to know how much carbon dioxide is used each day, both for bookkeeping records and to detect the presence of leaks which would cause high consumption.

The CO_2 inlet line has an orifice, but a suitable totalizing flow meter would have been fairly expensive. Since it is permissible to control the CO_2 flow in an on-off manner we were able to totalize the flow in a very simple way.

The pneumatic controller was set for on-off operation and equipped with a pressure switch which energized both a timer and a solenoid valve supplying air to a diaphragm control valve in the CO_2 line. Thus the timer would show the cumulative time the CO_2 flowed during any interval. Then by calibrating the flow rate through the orifice and multiplying this rate by the number of hours the system was energized during 24 hr., we would get our total consumption for the day.

This system is also suitable for certain other integrating jobs, for example, determining the time a pump controlled by a level controller is on each day. Knowing the pumping rate it is easy to calculate how much liquid has been pumped in a day or other desired interval.

★ **Winner of June Contest—J. Moziek**

"Control Cooling Jacket Temperature With Auto Thermostat"

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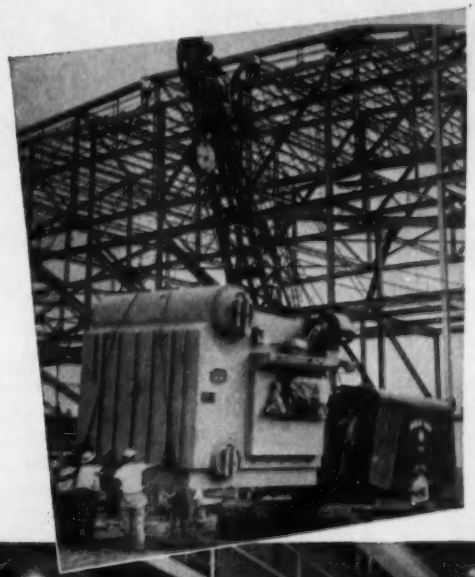

Vogt steam generating units are available in types and sizes to meet individual plant needs for power, processing or heating.

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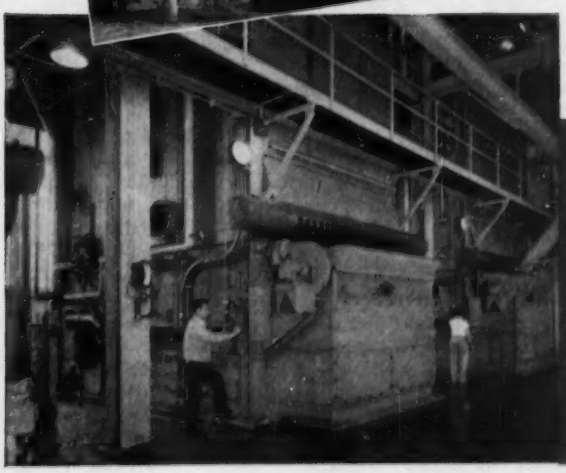

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Quick Method Finds Solids Percentage in Slurries

Gene E. Lightner

Process Engineering Group,
Hastings Chemical Div.,
Chemolite Plant,
Minnesota Mining & Mfg. Co.
St. Paul, Minn.

It is often desirable to know the percentage of solids in a slurry without taking time to dry a sample of known weight. A speedy method is to take a sample of known volume and weigh it, comparing the weight per unit volume with a plot of sample weight versus percent solids. Such a plot can be obtained for a particular slurry with a minimum of experimental work according to the following analysis.

The total volume of a sample of solids suspended in liquid is equal to the volume of the liquid plus the volume of the solids. Also, the total weight of the sample equals the sum of the weight of the liquid, plus the weight of the solid. The weight of either liquid or solid is equal to its volume, times its density:

$$V_L + V_S = V_T \quad (1)$$

$$\rho_L V_L + \rho_S V_S = W_T \quad (2)$$

Also, the fraction of solids in the slurry is:

$$X = \rho_S V_S / W_T \quad (3)$$

where V_L and V_S are respectively the volume of the liquid and the solid, V_T is the total volume of the sample, ρ_L and ρ_S are the densities of liquid and solid, W_T is the weight of the total sample, and X is the fraction of solids in the sample.

All quantities except V_L and V_S in Eqs. (1) and (2) can be measured readily. The quantity V_S can be found in terms of the measurable quantities and substituted in Eq. (3). Thus:

$$V_S = (W_T - \rho_L V_T)/(\rho_S - \rho_L) \quad (4)$$

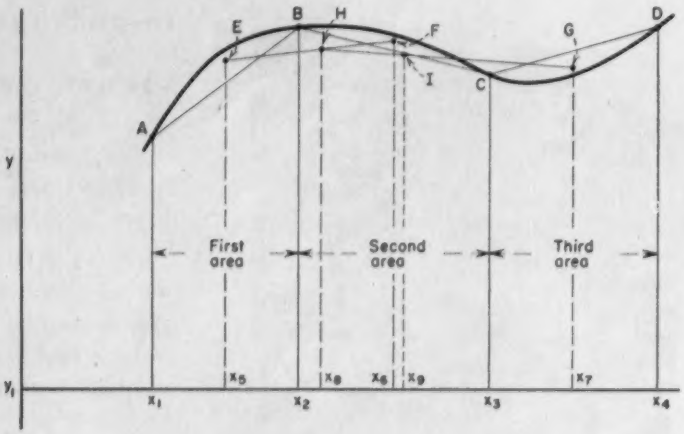
and

$$X = \left(\frac{\rho_S}{\rho_S - \rho_L}\right)\left(1 - \frac{\rho_L V_T}{W_T}\right) \quad (5)$$

All the quantities in Eq. (5) are measureable. ρ_S can be found by observing the change in volume when a known weight of the solid is added to a known volume of the liquid, since ρ_S is equal to the weight of solid divided by the increase in volume. Eq. (5) can be plotted as X against $1/W_T$ and will yield a straight line passing through the origin so that only one point need be determined experimentally to make the plot.

In making subsequent determinations through use of the resulting plot it is well to use a 100 ml. volumetric flask with a ground glass stopper to insure a sample of constant volume. Weigh 100 ml. of the slurry sample and compare with the plot. If the sample contained no solid and the liquid were water, its weight would be 100 grams and its solids percentage zero, i.e., the origin of the plot. Any weight above 100 grams represents solids and the chart will show the percentage.

Since Eq. (1) assumes that the volumes of liquid and solids are additive, Eq. (5) may also be used for ideal solutions. Thus it applies with a surprising degree of accuracy to many solutions and emulsions.



Simple Scheme Integrates a Curve

George C. Szego

Head, Department of Chemical Engineering, Seattle Univ., Seattle, Wash.

Chemical engineers often have the problem of integrating a curve between limits. The curve may be capable of mathematical expression, in which case one has the options of integrating mathematically, or of performing the operation graphically. Or, the curve may be simply a plot from a series of data points for which a mathematical expression may be time consuming to derive. In this case, one effective possibility is graphical integration. Such integration is needed in many problems in the fields of fluid flow, heat transfer, differential distillation, drying, humidification, kinetics, economic studies, and especially in the sizing of packed equipment.

There are a number of well known methods for graphical integration, such as the trapezoidal rule, Simpson's rule, counting squares, averaging small areas inside and outside the curve and, finally, using a planimeter. The method to be described here is not well known. It is simple and easy to perform and can give an accuracy of better than ½%, or better than needed in engineering calculations. Compared to the often-described method of cutting out and weighing the unknown area in comparison with a known area, it is quicker and does not require any special equipment such as an accurate balance.

This method[1, 2, 3] depends on the fact that any portion of a curve (provided that it does not

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FIG. 2309—Flush Bottom Tank Valve for 150 Pounds W. P. Disc Opens Into Tank.

FIG. 2453G—Stainless Steel O. S. & Y. Gate Valve for 150 Pounds W. P.

FIG. 3059G—300-Pound Steel Flanged End Lubricated Plug Valve.

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include points of inflection) can be approximated by part of the arc of some parabola. It can be proven analytically that the mean ordinate of an area bounded at the bottom by a base line, at the sides by ordinates at x_1 and x_n, and at the top by an arc of a parabola, is determined by taking an ordinate mid-way between x_1 and x_n, and extending it from the base line upward to a point $\frac{4}{3}$ of the distance from the chord of the curve to the curve itself. If this statement seems difficult to follow, it will become clear during the explanation of the graphical process.

The graphical method consists in dividing the area under the curve into a number of smaller areas between the integration limits at A and D. The diagram shows a curve consisting of a fairly long section which in its entirety may not approximate a parabola closely; plus a point of inflection and a shorter section of curve. We draw verticals at the limits, A and D, and one at the point of inflection C. Then, because of the length of curve section AC, we divide it into smaller areas by a vertical at any convenient point B. If this section of curve had been still more irregular, we might have divided it into still smaller areas for greater accuracy.

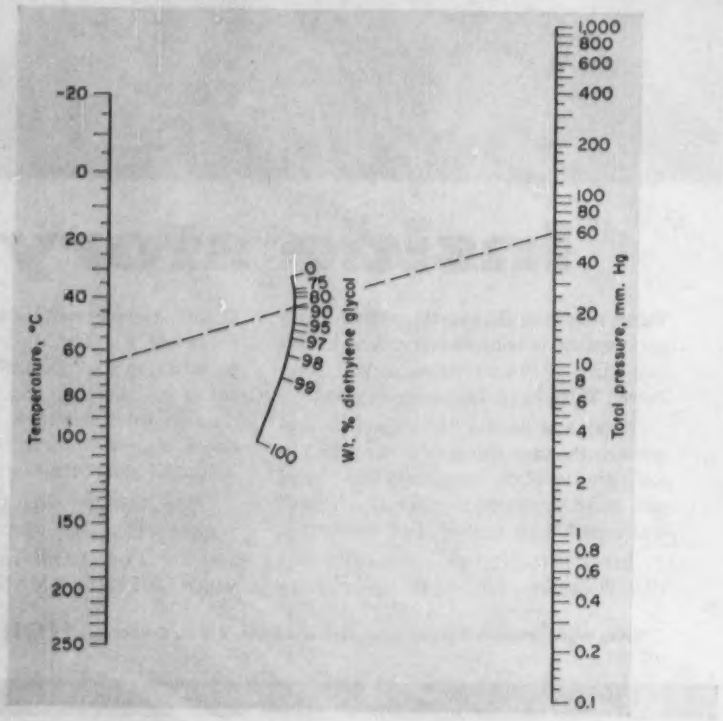
Area under any curve may be obtained by finding its mean ordinate and multiplying its value by the value of the base between the curve limits. The base line need not be the x-axis but can if desired be at any y-value. Chances of error are minimized since the coordinates can be measured or read directly from the plot with a high degree of accuracy. Also, the area calculated automatically possesses the correct units.

In the plot, which has been divided into the areas x_1ABx_2, x_2BCx_3, and x_3CDx_4, we now draw the three chords AB, BC, and CD. Next step is to erect verticals at the midpoints of the three base segments, namely at x_2, x_3 and x_4. Visually, we then locate points E, F and G on these verticals, so that these points lie $\frac{4}{3}$ of the distance from the chord to the curve. Then x_2E is the mean ordinate of the first area x_1ABx_2 and the area equals $(x_2E) \times (x_1x_2)$. The other two areas are integrated similarly, and sum of the three areas then equals the total area x_1ABCDx_4.

It is interesting from a geometric standpoint that the graphical construction can be carried still farther so as to locate a single mean ordinate for the entire area x_1ABCDx_4. To do so we connect E and F and locate H on the mid-ordinate between x_1 and x_2. Then we connect H and G and locate I at x_0 on the mid-ordinate between x_1 and x_4. The dotted line x_0I is then the mean ordinate for the entire area, and the area equals $(x_1x_4) \times (x_0I)$.

References

1. Levens, A. S., "Graphics in Engineering and Science," p. 485-506, John Wiley & Sons Co., New York, 1954.
2. Willers, F. A., "Practical Analysis," p. 146-161, Dover, N. Y., 1928.
3. Moore, A. D., *J. Eng. Education*, 31, 452-9 (1941).



Vapor Pressure of Diethylene Glycol

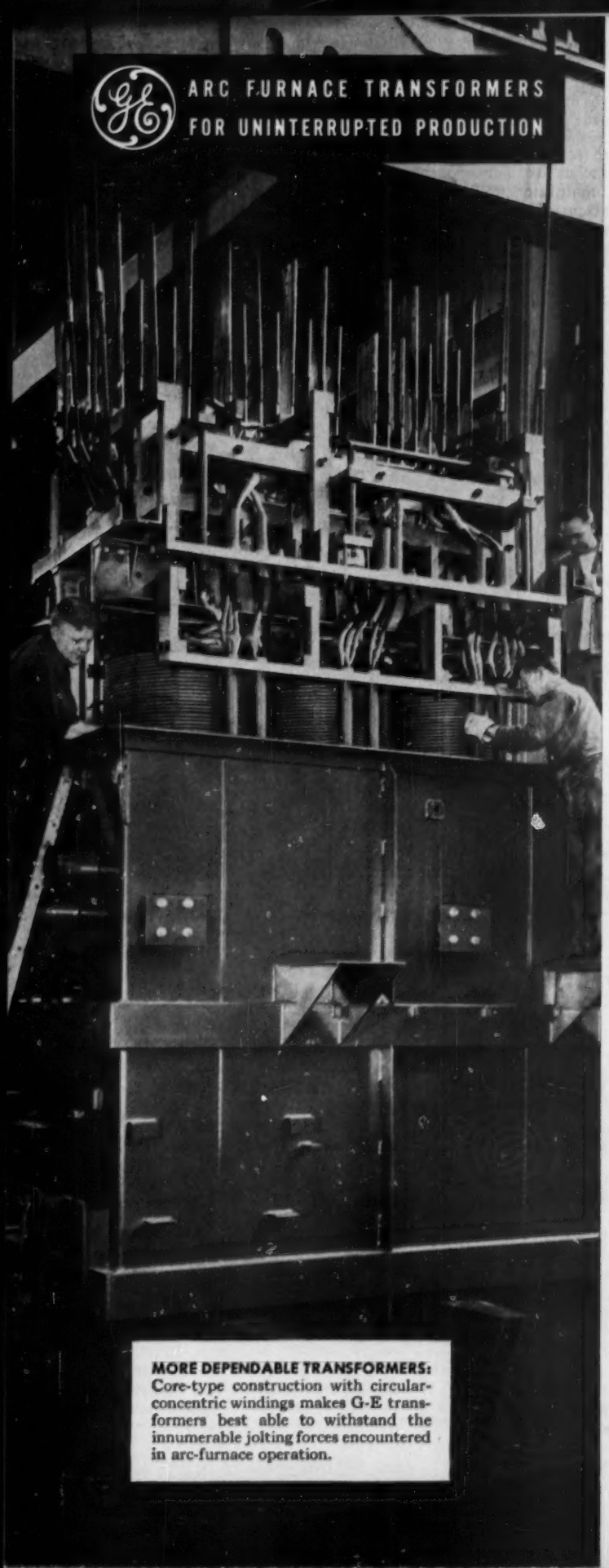
D. S. Davis
Virginia Polytechnic Institute, Blacksburg,

Data published by Carbide & Carbon Chemicals Corp. (Chart 495), dealing with the effect of temperature on the total pressures of aqueous solutions of diethylene glycol can be correlated by means of the equation

$$\log P = A + B/(t + 273)$$

where P = total pressure, millimeters of mercury, t = temperature, °C., and A and B depend upon glycol concentration.

Use of the accompanying line coordinate chart, which enables rapid and reliable solution of this equation, is illustrated as follows: What is the total pressure of an aqueous solution that contains 90 weight % of diethy-



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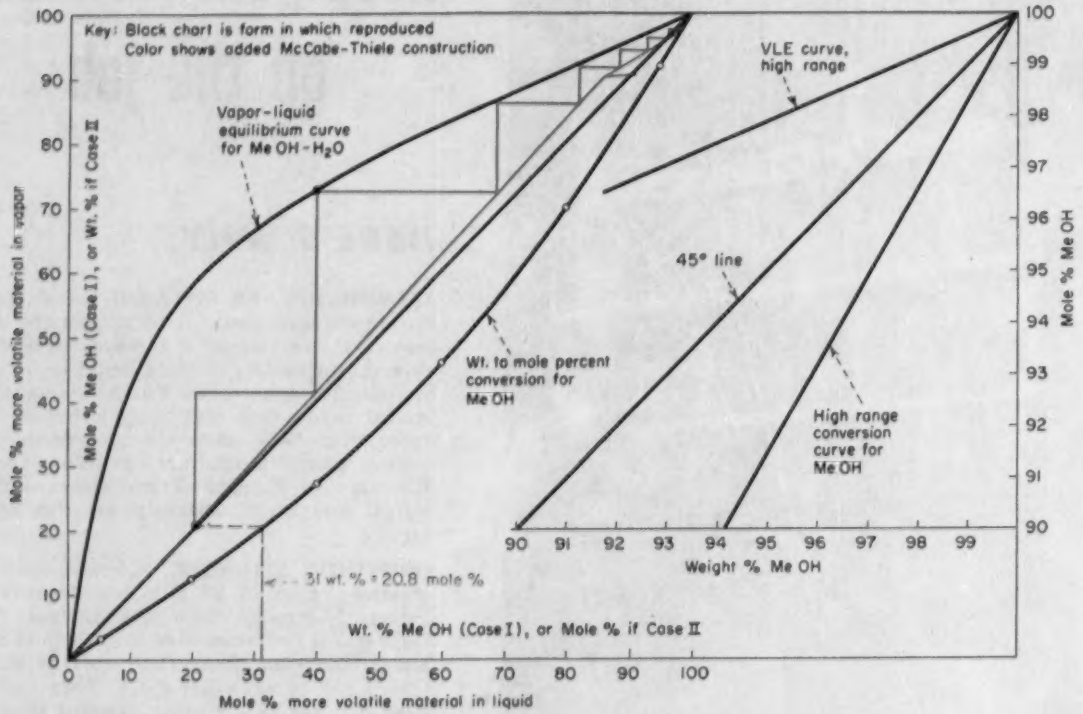
lene glycol when the temperature of the solution is 65 C.? Connect 65 on the temperature scale and 90 on the concentration scale with a straight line and note that it intersects the total pressure scale at 60 mm. Hg. Below what temperature should one maintain a 95% aqueous solution of diethylene glycol so that the total pressure will not exceed 100 mm. Hg? Connect 100 on the total pressure scale and 95 on the concentration scale with a straight line (not shown) and read the maximum allowable temperature as 90 C.


Key: Black chart is form in which reproduced
Color shows added McCabe-Thiele construction
Vapor-liquid equilibrium curve for Me OH - H_2O
VLE curve, high range
45° line
Wt. to mole percent conversion for Me OH
High range conversion curve for Me OH
31 wt. % = 20.8 mole %
Mole % more volatile material in vapor
Mole % Me OH (Case I), or Wt. % if Case II
Wt. % Me OH (Case I), or Mole % if Case II
Mole % more volatile material in liquid
Weight % Me OH
Mole % Me OH

Better Way to Use Distillation Diagrams

Ralph W. Fisher
Plant Superintendent, Chemical Div., General Mills, Inc., Kankakee, Ill.

When computing binary fractional distillations by the McCabe-Thiele method it is necessary to convert weight percentages to mole percentages. Also, it is often necessary to use trial-and-error methods, involving many such conversions and the drawing of numerous graphs, which means a very messy appearance of the work graph from the many erasures. This is true when using the method for establishing such things as optimum reflux ratio, or when investigating an existing column to see if it can handle a job for which it wasn't designed.

We have made use of a couple of simple improvements to obviate these problems. One is to draw a weight percent-mole percent conversion curve directly onto the equilibrium diagram so that the needed mole percent can be entered into the diagram without actually having to be read and plotted. The other is to make several prints from the original plot of the equilibrium diagram and conversion curve by one of the photo-reproduction methods. Many erasures can be made on such prints without harming them.

The diagram above shows how the conversion curve is added. Make the necessary calculations for the weight percent-mole percent conversion at half a dozen properly spaced points between 0 and 100% and plot beneath the conventional 45° line of the McCabe-Thiele diagram, using the same scale used for the vapor-liquid equilibrium curve. If the more volatile component is the higher in molecular weight (Case I), use the horizontal axis for the weight percent scale, reading mole percent on the 45° line in horizontal alignment with the conversion curve intersection. If the more volatile component is the lighter (Case II), use the vertical axis for weight percent and read mole percent on the 45° line vertically above the conversion scale intersection. This keeps the conversion curve below the 45° line and out of the way.

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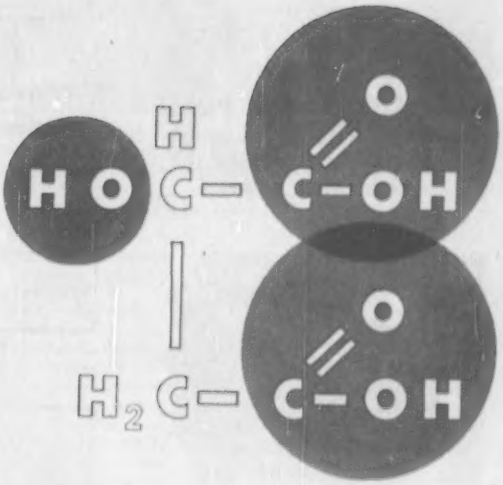

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. . . dispersing agent in the manufacture of shellac and shellac substitutes

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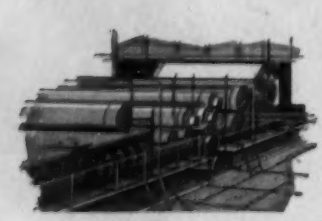

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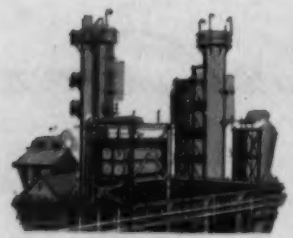

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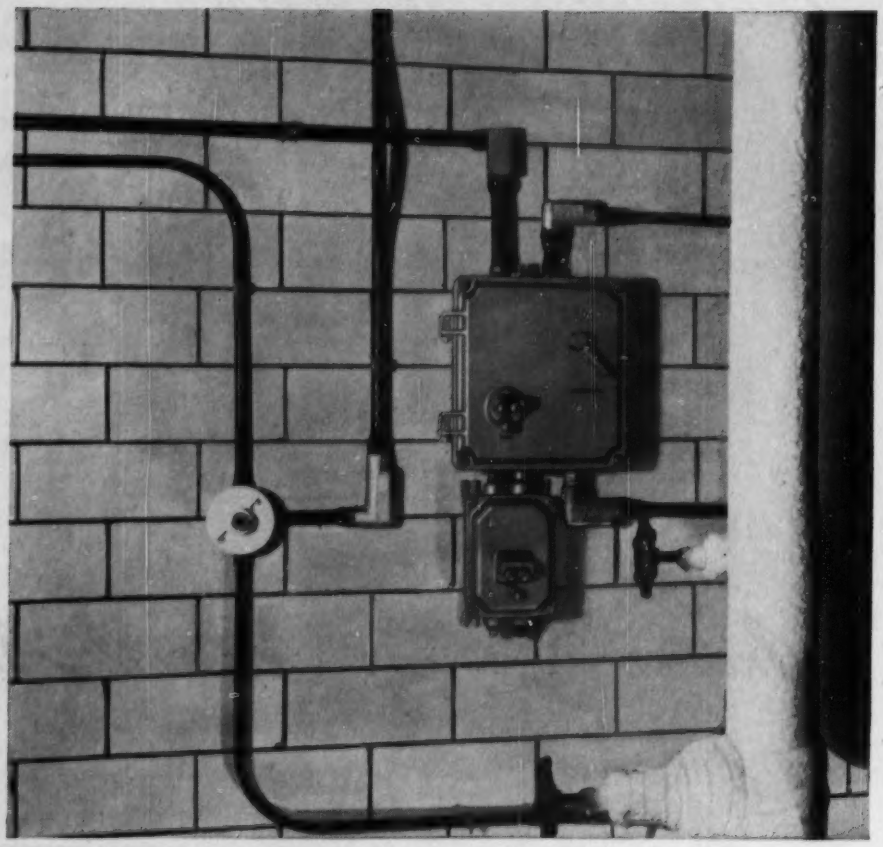

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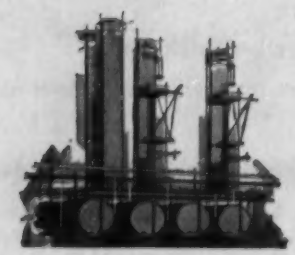

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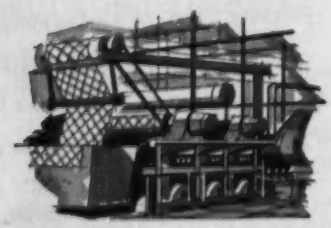

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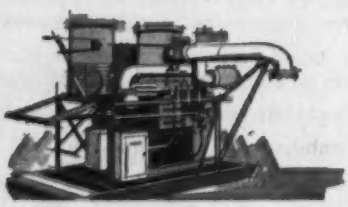

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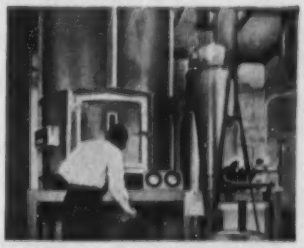

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Build a Career in Patent Law

Barry Moyerman, Atlas Powder Co., Wilmington, Del.

Careers in the patent field seem to have a special kind of fascination for engineers. But, unfortunately, most technically trained men have only a vague idea of just what job opportunities are open to them.

Fewer still know what these jobs require, what training is needed, how to get it, how long it will take, what shortcuts to follow, what the rewards are, etc. Yet, interested chemical engineers can find satisfying and rewarding work in this field.

In this article, I'll try to answer some of these questions and outline the various careers which are open to you.

Defining the Job

A good starting point for a survey of opportunities in patents is the set of definitions above.

Other titles, such as patent broker, patent developer, patent searcher, patent draftsman, etc., are also connected with patent activities. These refer to businessmen* or their employees who render specialized, nonlegal services to patent owners or patent attorneys. Detailed discussion of these occupations is beyond this article's scope.

Patent agents, attorneys and examiners each have their own responsibilities and their own sphere of activity. There are very important differences between the activities of each. In general, a patent agent's activities as well as those of a patent examiner are confined to the U. S. Patent Office. A patent attorney performs additional functions in the courts and in giving his clients legal advice and services.

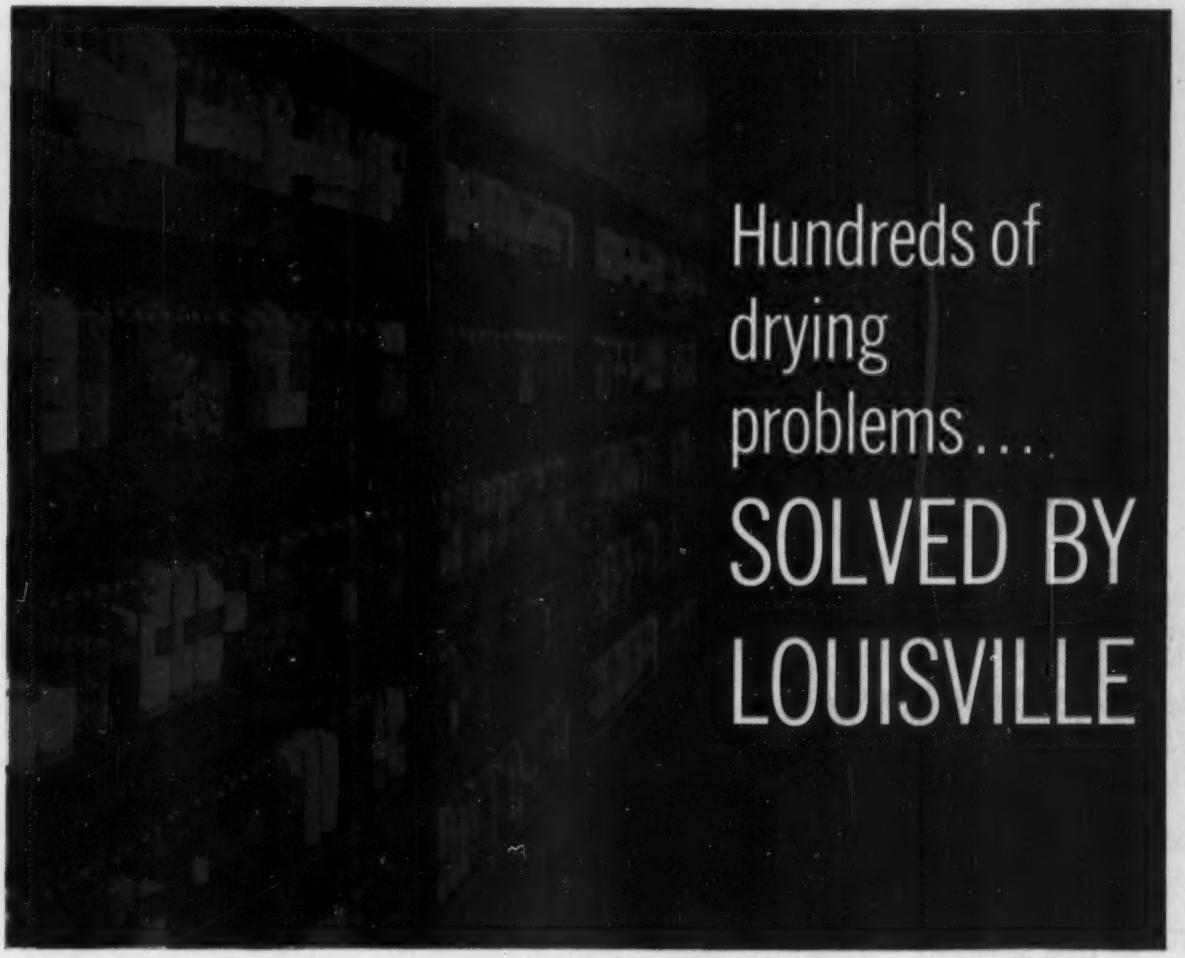
What the Patent Agent Does

The patent agent has four important functions in the patenting process.

- Advising clients on the patentability of their ideas and discoveries. To give this advice he makes a search of the existing patents and literature in the field (or has a search made by a patent searcher). He then evaluates this "prior art" as it relates to his client's invention.
- Preparing patent applications. This involves writing the specifications, drafting claims and supervising the preparation of drawings. The drawings are usually made for him by a patent draftsman.
- Filing the application and prosecuting it before the Patent Office. This process may be a long one (3 to 4 years) and often requires the writing of amendments, the answering of arguments advanced by the corps of examiners, interviews with the examiners and, if necessary or warranted by an unfavorable decision, the prosecution of an appeal before the Patent Office Board of Appeals.
- Representing his client in

* Meet your author on page 376.

*One frequently used title, patent solicitor, refers to either patent agents or patent attorneys. This term is used loosely. It actually has no definite meaning in the United States.



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any interference which may be declared by the Patent Office. (An interference is a proceeding instituted [by the Patent Office] for the purpose of determing the question of priority of invention between two or more parties claiming substantially the same patentable invention . . .)

In addition, the patent agent may also prosecute trade mark matters within the Patent Office.

What the Patent Attorney Does

The patent attorney performs all of the functions listed for the patent agent and these others as well:

- Represents clients in Federal Courts in the District of Columbia and in the U. S. Court of Customs and Patent Appeals on appeals from decisions of the Patent Office Boards.
- Gives legal opinions relating to infringement (a non-licensed use of a patented invention) and enforcement of patent and trade-mark rights. In addition, he often gives advice concerning matters of unfair competition and contracts involving patents such as license agreements, assignments, grants, etc.
- Initiates infringement suits on behalf of his client in whatever court properly has jurisdiction over the alleged infringing party or over the subject matter.
- Defends his client in invalidation proceedings and other

"Technical training is imperative for patent agents and attorneys."

legal actions which generally relate to his client's patent position.

Depend on the nature of his practice, he may handle cases involving copyrights and trademarks as well as those involving patents.

What a Patent Examiner Does

While the patent agent or attorney acts for the inventor, the patent examiner works on the other side of the fence. He

"For general work in the patent field engineering versatility is the important technical factor."

represents the federal government in evaluating patent applications and in deciding whether a patent should be issued for a claimed invention.

An assistant examiner performs the bulk of the work and prepares a decision which, upon the approval of the chief primary examiner of his technical division, becomes an official decision of the Patent Office.

The position of the primary examiner and those of similar and higher officials (i.e. members of the Board of Appeals) in the Patent Office carry an unusual degree of respect and prestige not only because of the high qualifications required but because of the very important judicial decisions these men are called upon to make.

Now that we've covered the fundamentals, we'll delve into the career opportunities of patent law—and cite the factors which may help you decide if its the career for you.

Here's What's Required

Certain abilities and aptitudes are a must for anyone who hopes to succeed in the field of patent law. These include:

- Facility in the use of language. The ability to write clearly, accurately and concisely is imperative. Each word in a patent claim must be carefully chosen and properly used. The courts have very often held patent claims invalid because the language used to express a basically patentable idea was loose and inaccurate. The writing of amendments, briefs and other legal documents requires the same ability.
- Ability to read and understand technical writing as found in patents, text books and scientific works is a necessity for attorneys, agents and examiners.
- Talent to grasp engineering concepts quickly and to put into words the "how" and "wherefore" of the operation of a machine, the attributes of an article of manufacture or the steps of a process.
- Ability to get along with people. Although in some fields of patent practice there is perhaps less personal contact with people than in others, there are always co-workers, patent draftsmen and searchers and the Corps of Examiners of the Patent Office who have to be dealt with.

Need Technical Background

Technical training is imperative for agents and attorneys. As far as the Patent Office itself is concerned, one of the requirements for admission to practice before it is that the applicant shall be " . . . possessed of . . . scientific and technical qualifications necessary to enable him to render applicants for patents valuable service."

"A patent agent need not be a law school graduate. The attorney, on the other hand, should have a law degree and must be a member of the bar."

Proof of basic training in scientific and technical matters is required at the time that application is made to take the qualifying examination given by the Office. A bachelor's degree in any field of engineering or physical science is adequate for the purpose of meeting this requirement.

The question of just what scientific training is best for patent law can only be answered in terms of the potential patent worker's professional goals. A petrochemical company may want for its staff only men who have a background in organic chemistry and might even require graduate work in that field. However, aside from corporations whose activities are in a particular field, or firms of patent attorneys large enough to have specialists in each field, there is no demand for a specific type of scientific or engineering background.

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is the important technical factor. For this reason, many people feel that practical experience in engineering and the sciences is of more value as a background for patent law than graduate study. Especially in private practice, it's almost impossible to be technically prepared for every new client, regardless of training and experience. How well one understands the client's idea and how quickly one can absorb the technical background necessary for its evaluation and proper presentation to the Patent Office are the factors which count.

Legal Training Needs Differ

Legal training requirements differ for agents and attorneys. An agent need not be a law school graduate. The attorney, on the other hand, should have a law degree and must be a member of the bar.

> "How can patent law really be mastered? The only answer is to learn by doing."

In any daytime program it takes three years to receive an LL.B. from an accredited law school. Schools offering an evening program usually require four years attendance. Summer sessions, of course, offer an opportunity to complete the work at a faster pace. Following law school graduation, considerable effort is required to study for and pass a bar examination. Requirements for admission to the bar vary from jurisdiction to jurisdiction.

How to Learn Patent Law

Unfortunately, few law schools offer courses in patent law. When offered, courses are usually electives and form a comparatively small part of the over-all undergraduate law school curriculum. These courses are of value but it should be remembered that it is not the function of law schools to turn out full-fledged patent attorneys.

How then can patent law really be mastered? The only answer is to learn by doing. Some of the ways to do this will be discussed below. But it is only after having learned substantive and procedural patent law and writing patent applications that one can hope to pass the examination for admission to practice which the Patent Office gives to candidates for registration either as agents or attorneys.

Job Opportunities Abound

A distinction should be drawn immediately between two phases of a career in patent law: an apprenticeship period and true career status and recognition.

The law school graduate, regardless of technical background, must find a first job which offers ample training in the field of patent law. If he is fortunate, the same job can become more and more rewarding as he gains competence, passes the Patent Office examination and generally becomes of greater value to his employer.

Unfortunately, more often than not, such employment continuity does not exist. Having served an apprenticeship, a change of employment is often necessary if the maturing patent attorney is to work at his maximum level of endeavor.

Career opportunities for the trained man are numerous. They include positions with private law firms, corporate patent departments and government. The nature of the duties, the degree of responsibility and the latitude of subject matter dealt with all vary with the position involved. Some corporate patent attorneys do nothing but prosecute applications before the Patent Office in a particular scientific field. Other attorneys, in private practice and representing clients in many industries, are busy in the courtroom or around the conference table as often as they are involved in the prosecution of applications.

> "Career opportunities for the trained man are numerous."

Individual interests and temperament determine the selection of long range career opportunities.

Short Cuts for Young and Old

You've probably been doing some mental addition while reading these requirements. Formal education involves four or five years of engineering training plus three or four years of law school—a total of 7 to 9 years. The hurdle of the bar examination requires several months and is followed by a legal apprenticeship of several years. In addition, there is the Patent Office registration examination.

> "However it's figured, the total amount of time spent in training is impressive and often discouraging. But it is possible, by thinking ahead, to save some time. This is particularly true for younger men."

However it's figured, the total is impressive and often discouraging. But it is possible, by thinking ahead, to save some time. This is particularly true for younger men.

The biggest single factor in time-economy is the existence of night law schools. It is possible to complete a regular law program in four years by at-

Next Month: How to Get More Out of a Convention

The coming of the convention season stirs mixed emotions in any group of engineers or executives. Some look ahead with anticipation to the chance to get away from the office. Others, more convention-hardened, tend to view such meetings as just a part of the job—a part that's often guilty of wasting valuable time. Next month, You and Your Job will explore some of the methods which both groups can use to win the maximum in information, contacts and enjoyment from their convention-going.

Held at 3000°F for five hours, these four brick, commonly recommended to resist high temperatures, show varying effects. Samples 1, 2, and 3 softened and slumped to different degrees, indicating loss of usefulness even below this temperature. Sample 4, a Mullfrax® electric furnace mullite refractory, is unaffected by the heat.

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tending classes five nights a week. It's no easy job, especially for married men, but the training is substantially as good as daytime training and by diligent studying it's possible to become as well versed in legal concepts as those who devote full time to legal studies. This leaves the daylight hours for a regular job.

"The biggest single factor in time-economy is the existence of night law schools. By choosing a job in the field of patents, both legal education and an apprenticeship in patent law can be undertaken at the same time."

By choosing a job in the field of patents, both legal education and an apprenticeship in patent law can be undertaken at the same time. There is no reason why completion of a full law school course need be a prerequisite for the patent apprenticeship. By combining the two they can supplement each other.

Finding the Opportunity

A unique opportunity exists in Washington, D. C., at the U. S. Patent Office. Positions in the Corps of Examiners are usually available to qualified technical graduates.

The starting salary is adequate for a single man and, as in all government service, there is opportunity for advancement and a secure permanent career. The work combined with the training programs conducted for examiners offer one of the best opportunities for learning basic patent law which exists.

The responsibilities given the beginner and the scope of the work handled by an individual examiner exceed those found in the usual patent apprenticeship. In addition, there are several good evening law schools in the area.

At the end of four years, the student has an LL.B., four years of good experience as an examiner and, because of a Patent Office rule which allows for a waiver of examination for former examiners with three or more years of experience, he can be admitted to practice before the Patent Office if he leaves.

Some corporations also have extensive training programs for their new patent employees which help them prepare for the Patent Office registration examination. Most of them also encourage their men to attend evening law schools. An engineer currently working for such a corporation should be able to transfer to the patent department without too much difficulty, particularly in these days of personnel shortages.

What Are the Rewards

A career in patent law can be most rewarding. Financial earnings reflect the difficulty and length of the training required to achieve competence. In addition, this career combines the most challenging aspects of technology with equally interesting legal problems.

"Financial earnings reflect the difficulty and length of the training required to achieve competence."

Currently, patent examiners start at either $4,480 or $5,335, depending on the extent of their training and industrial experience. In six months those who start at $4,480 receive raises to bring them up to the higher figure. In either case a promotion in grade and a salary boost come after a year at $5,335. Top level on the examiner's salary scale pays more than $10,000 per year.

Industry's starting rate for a patent attorney with three years experience as a patent examiner runs from about $8,500 on up. Progress to the $15,000 to $20,000 bracket within ten years is fairly usual.

Income of patent agents and patent attorneys in private practice varies widely depending on the individual and his practice. But it's safe to say that it compares favorably with industry salaries.

There is also the rewarding feeling of direct participation in our Patent System, a system which has played a large part in the continued technological advances of American industry. No finer summary of the function of that system can be found than that inscribed over the Patent Office entrance, "The patent system added the fuel of interest to the fire of genius." The author, also an inventor, was Abraham Lincoln.

SALARIES

. . . *Government Ups Ante*

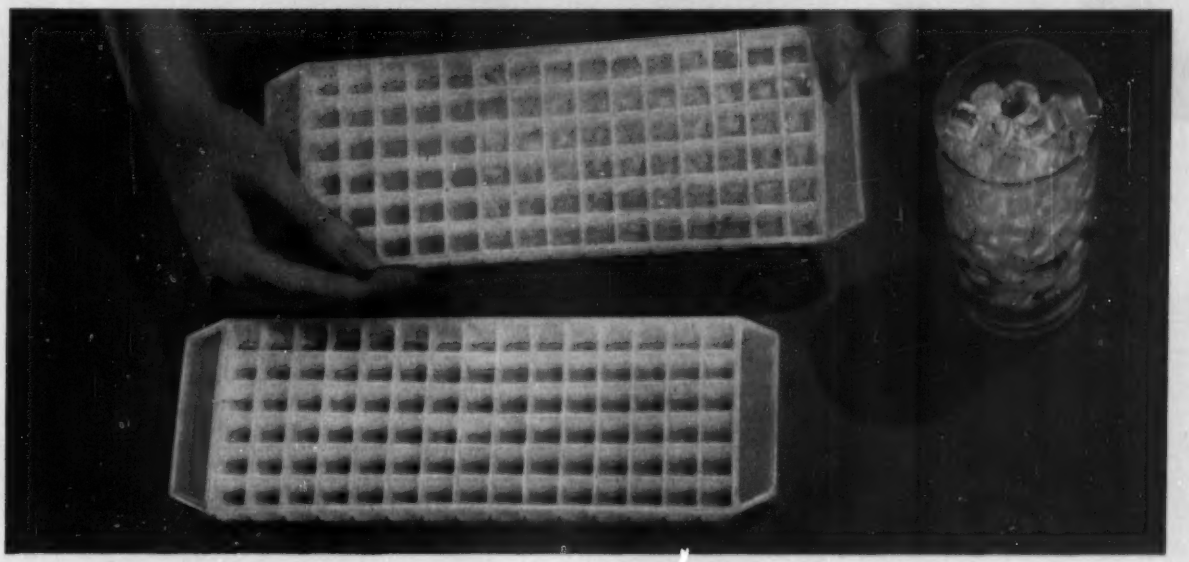
Industry competition and pressure to boost salaries of government engineers and scientists has resulted in Civil Service Commission permission for federal recruiters to dangle fatter offers before prospective employees. A general boost for other professional employees is also in the works.

For a BS degree, no industrial experience, beginning pay is now $4,480 per year. An MS with no industry experience can command $5,335. Each rate is $810 higher than the top offer to nontechnical men with equivalent qualifications.

But despite Civil Service's effort to meet stiffer industry competition for engineers, government salaries still lag well behind industry offers. This year's BS holder had little trouble caging $4,800 to $5,200 yearly to start and, if he had any worthwhile work experience, he could push this up another $200 to $500 per year.

Those with an MS generally received offers in the $5,500 to $6,000 range. Doctorates were usually good for $7,000 to $9,000, with several instances of $10,000-and-up offers.

Observers are already predicting that next year's recruiting drives will smash this year's records. Many companies have already made their reservations for interviewing time at the colleges and universities.



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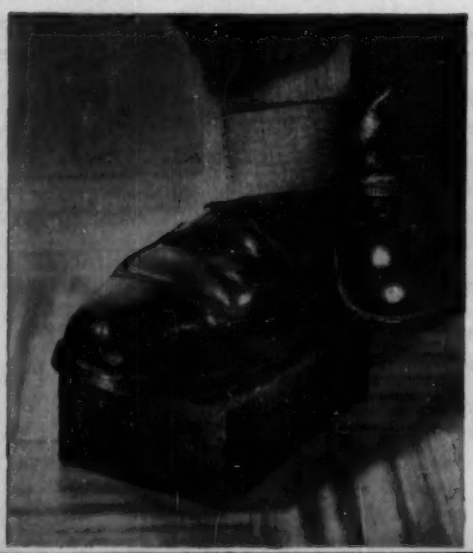

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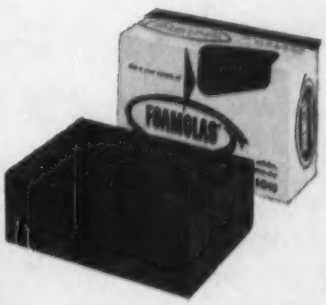

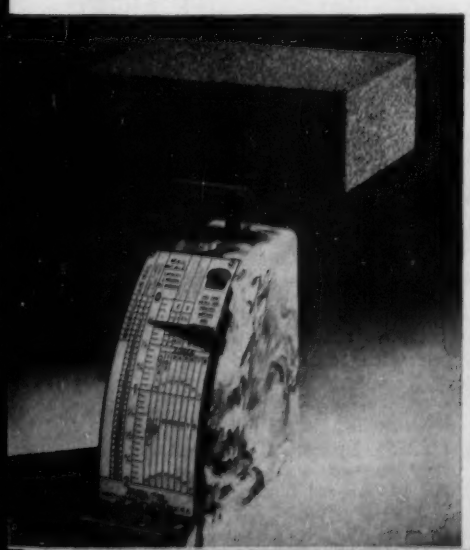

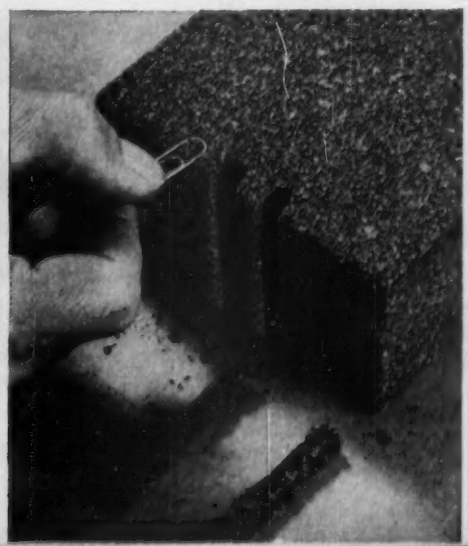

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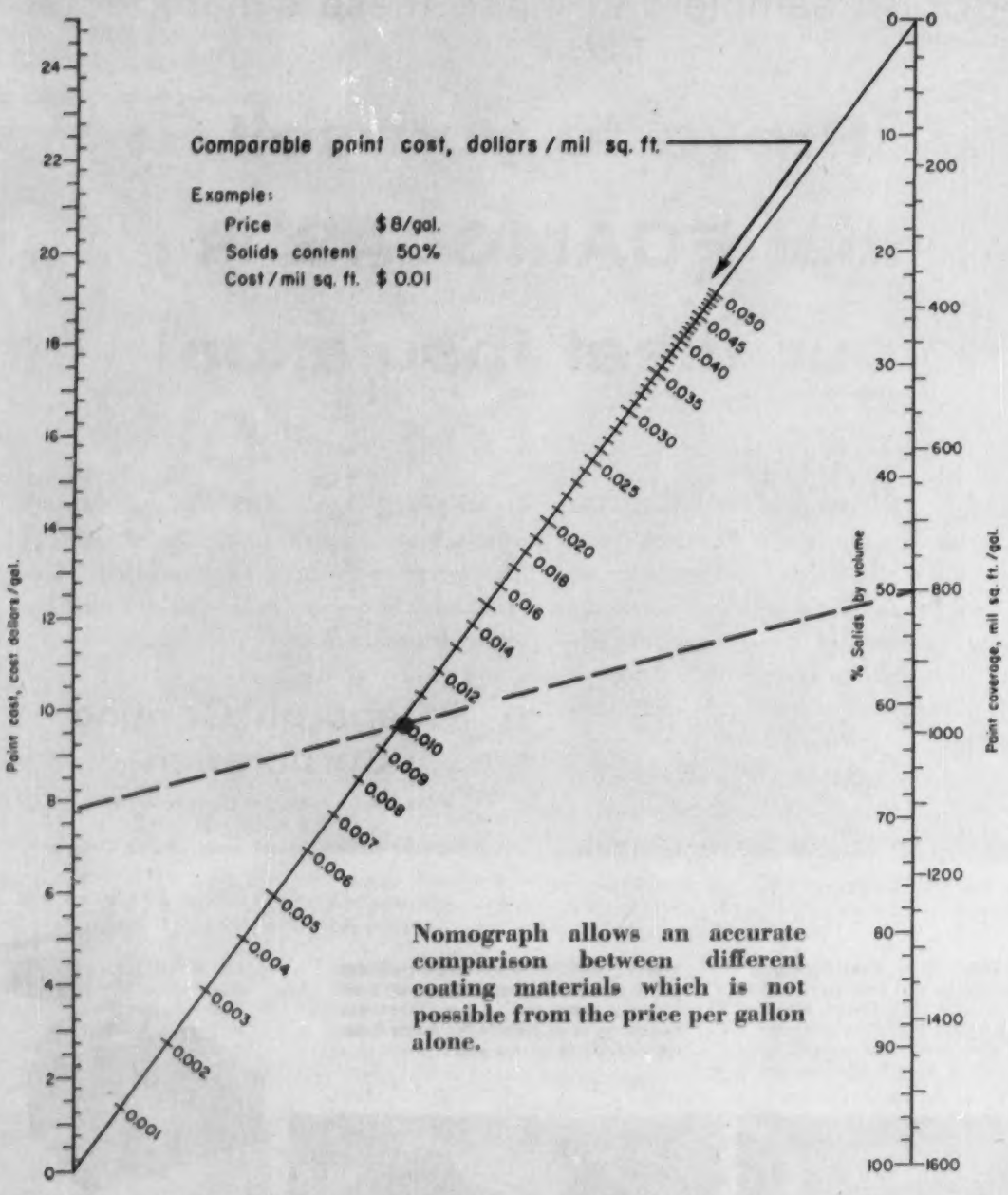

Comparable paint cost, dollars / mil sq. ft.
Example:
Price $8/gal.
Solids content 50%
Cost / mil sq. ft. $0.01
Paint cost, cost dollars / gal.
% Solids by volume
Paint coverage, mil sq. ft. / gal.
Nomograph allows an accurate comparison between different coating materials which is not possible from the price per gallon alone.

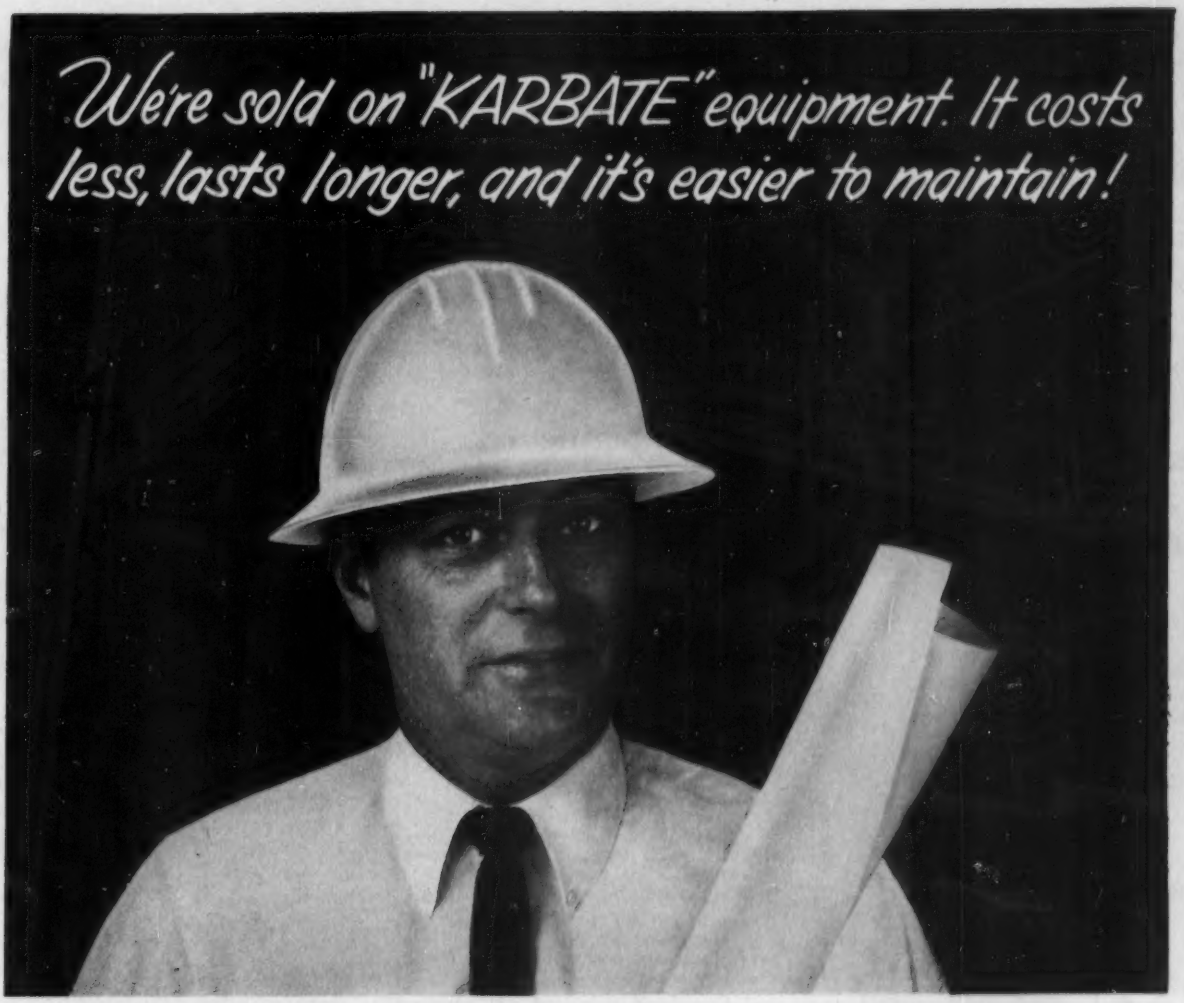
Method for Finding Comparable Paint Costs

V. B. Volkening and J. T. Wilson, Jr., Dow Chemical Co., Freeport, Tex.

The need for a method to determine actual cost of paint materials becomes increasingly acute as the number of coating resins continue to increase at a rapid rate.

For the industrial consumer, the price per gallon alone is no criterion. Price per gallon together with total solids of the paint by volume is necessary to

* Meet your authors on page 377.



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obtain a cost per "solid volume" comparable for all organic coatings sold by volume measure.

This comparable cost may be determined from the following equation:

$$N = W/(1604\ V)$$

Where N = Comparable paint cost, \$/mil sq. ft.; W = Paint cost, \$/gal.; V = Solids by volume, fractional gallon; and 1604 = Mil square feet per gallon = $(231 \times 1{,}000)/144$.

From this equation a nomograph has been drawn to allow quick comparison between different materials—the same resin type from different sources of supply, or different resin types from the same source. The theoretical paint coverage or mileage[1] is a corollary of the percent solids by volume and may be read off the right hand scale directly opposite the solids concentration percentage.

This nomograph is designed for "in the can" comparison. It must be assumed that it will be used only after the durability or quality of the materials in question have been established very carefully. This cannot be emphasized too strongly.

Since application costs are usually two to five times coating material costs, the latter have sometimes been considered unimportant. If, however, we realize that many of the materials used today are often four to ten times more expensive (per mil sq. ft.) than earlier conventional proprietary coatings, it will be obvious that material costs are important.

REFERENCE

1.. E. Gustave Shur, Interchemical Review, 14, 79-80, Autumn 1955.

◂Plastic Stack . . . Four Years Will Tell

These tall stacks harbor hot, corrosive vapors from magnesium chloride boil-down kettles at Dow's Freeport, Tex. plant. They're all the same size and shape.

But eight of them are black, and one is white.

Why this white sheep in the fold? The stacks have always been made of treated wood. But with the best treating material that engineers at Freeport have been able to find, they last three years at the most.

The new light-colored stack is part of an attempt to find a material that will outlast the treated wood and still be light enough and inexpensive enough to use. It's made of Fiberglas layers bonded with a polyester resin. Manufactured by the Pla-Tank Corp. of Houston, it's use in the Texas Div. is strictly on a "we'll see" basis.

"We can't tell just how long the plastic will stand up under our operating conditions until we've actually tried it," explains E. W. Ahlrich, superintendent of Magnesium Chloride B. "But from the results of short-term severe exposure tests, it's worth a trial.

"If it lasts four years, we'll consider it just about makes up for the extra cost. If it lasts longer than that—well, we may have all plastic stacks in the future.

"So far," he adds, "it has stood up okay."

To Avoid Mixed Steels

A new series of colors to identify its carbon and alloy steels has been developed by Joseph T. Ryerson & Son, Inc.

Various agencies and committees have explored the possibility of an improved color code, but only recently was a system devised that was both logical and meaningful in its use of colors.

Colors are applied to the steels as follows:

- Single colors are used to identify standard carbon and carbon manganese steels.
- The colors green, blue, yellow and pink always define carbon content.
- Centered dots of these carbon colors always indicate the heat treated condition.
- Centered dots of other than these carbon colors identify characteristics other than analysis, carbon range or the heat treated condition.
- Purple, black, white, orange, gold and brown designate related groups of steels.
- Red, in any form, always indicates special ground finish on a steel.

In developing this logical color plan, it was not necessary to change the colors of the most widely used carbon steels. For instance, there has been no change in the identifying color, green, used for C1018 and C1020 carbon steel bars. Blue remains the color for C1035, while yellow continues to be the color for C1042 and C1045 carbon steel bars.

Alloy steels, in the main, are designated with two colors—one indicating the particular analysis group and the other the carbon content.

As an example, black is used to designate alloy steels in the

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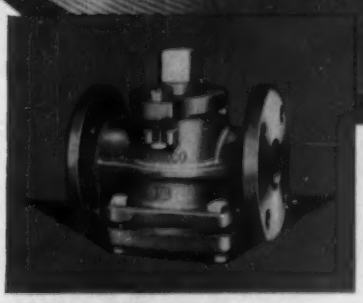

DURCO Type F valves are manufactured under one or more of the following patents. U. S. Patent Nos. 2713987, 2729420, 2735645, 2728550. Patented in Canada, 1955, No. 519424.

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4100 series. If the second color is yellow, this means that the carbon content is 0.40% to under 0.50%. If the second color (yellow) is in the form of a dot, this indicates that the 4100 series alloy steel with carbon of 0.40% to under 0.50% is in the heat treated condition.

Introduction and wide use of special free machining alloy steels is a comparatively recent development, making it necessary to establish identifying colors for them. The color purple, employed as a single color to identify special free machining carbon steel screw stock, is used in combination with other colors to designate special free machining alloy steels—in different series such as the 4100 series, 8600 series, etc.

Except for tool steel bars which are painted full length, identifying colors for bar stock are painted on one end.

An explanatory pocket size card, showing the various colors as used singly and in different color combinations to identify carbon steel bars, alloy steel bars, and steel plates, may be secured by writing to Joseph T. Ryerson & Son, Inc., Box 8000-A, Chicago, 80, Ill.

Permanent ICC Approval For Polyethylene Drums

After three years of test shipping, the Interstate Commerce Commission announced that molded polyethylene drums have been given the designation I.C.C.-28. Delaware Barrel & Drum Co. Inc., Wilmington, Del., announces that the containers have been approved for the commercial shipment of the following regulated products:

Alcohol, acids or other corrosive liquids not specifically provided for, hydrochloric acid, hydrochloric acid mixtures, hydrochloric acid solutions, inhibited and sodium chlorite solutions, hydrofluorosilicic acid, hydrofluoric acid, sulfuric acid, hypochlorite solutions, formic acid, formic acid solutions.

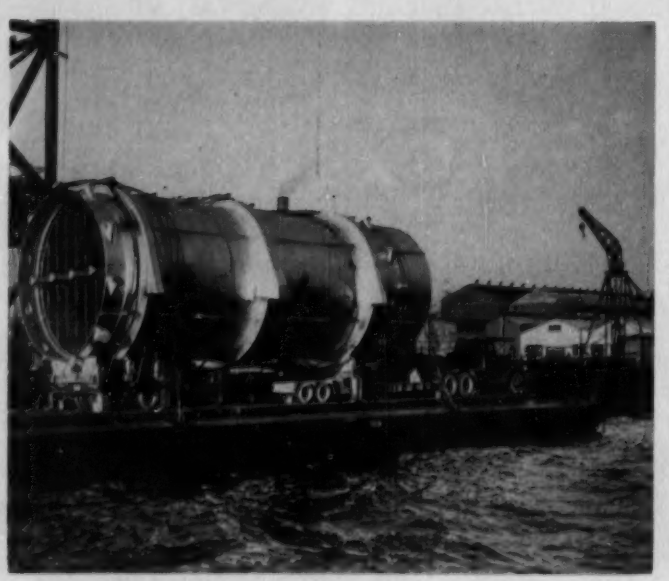
Temporary permits for the shipment of products not listed may be obtained from the Bureau of Explosives, 30 Vesey St., New York, N. Y. Permits are issued so that a safe transportation history may be obtained prior to the permanent inclusion in the Rules and Regulations of I.C.C. Non-regulated product shipments by rail and motor carrier were approved during early 1955.

Novel Method for Measuring Corrosion

The hydrogen effusion method, a novel technique for measuring the corrosion of metals at elevated temperatures and pressures in aqueous heat exchange systems, is the subject of a recent report of Navy research just released to industry through the Office of Technical Services, U. S. Dept. of Commerce.

This report contains an analysis of the limitations of prior techniques of corrosion rate measurement to determine the kinds of materials best suited to resist attack by aqueous media at elevated temperatures and pressure. The new system is based on the fact that, in a closed system at elevated temperature, the hydrogen which results from the corrosion reaction will diffuse through the walls of the metal at a comparatively rapid rate. This hydrogen is collected and measured in a vacuum system of known volume which surrounds the system under test, and the rate of hydrogen evolution thus measured gives a direct measure of the rate of corrosion of the metal.

This 18-page report, PB 111-772 "A Hydrogen Effusion Method for the Determination of Corrosion Rates in Aqueous Systems at Elevated Temperature and Pressure," Nov. 1955, M. C. Bloom and M. Krulfeld, Naval Research Laboratory, is available from OTS, U. S. Dept. of Commerce, Washington 25, price 50¢.



Stainless-clad Steel Accumulator for Hi-Temp Studies

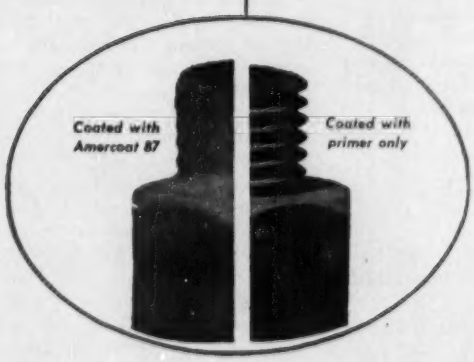
T-1 Carilloy heat-accumulator shell built by Newport News Shipbuilding and Dry Dock Co. for installation in the high-temperature structures research lab, Langley Aeronautical Laboratory, National Advisory Committee for Aeronautics. Note unique loading arrangement for the vessel.

you can

CUT YOUR MAINTENANCE PAINTING COSTS UP TO 50% *with* AMERCOAT 87 VINYL MASTIC

HERE IS HOW THIS REMARKABLE PROTECTIVE COATING CAN SAVE YOU MONEY:

1. Only one cross spray coat over a primed surface is required for complete protection—this means lower labor costs.
2. Fewer scaffolding and rigging shifts are required.
3. Less down time—dries to touch in minutes, eliminates the risk of contamination between coats.
4. Greater thickness means longer life—lower cost per square foot per year.



Amercoat 87's thixotropic characteristic helps provide extra thickness on sharp edges and irregular surfaces; it is non-porous and will not crack or check.

Amercoat 87 combines the time-tested chemical and weather resistance of vinyl coatings with the thickness of conventional mastics, yet is easily applied with standard industrial spray equipment.

We will be pleased to send you our technical bulletin describing this coating in detail.

Amercoat CORPORATION

DEPT. AH, 4809 FIRESTONE BOULEVARD, SOUTH GATE, CALIFORNIA Evanston, Ill. • Kenilworth, N.J. • Jacksonville, Fla. • Houston, Tex.

Alcohol Plant Has Unique Corrosion Problem

Since no one material will economically withstand all of the various strengths of sulfuric acid encountered in the process of making isopropyl alcohol, Shell Oil Co. of Canada, Ltd., in its new Montreal East petrochemical plant, employs a variety of alloys and inert materials to handle the various concentrations involved.

Isopropyl alcohol is made only from propylene derived from the gases from petroleum cracking units. Gases from either thermal or catalytic cracking are scrubbed to remove hydrogen sulfide and mercaptans. The propylene is then absorbed in concentrated sulfuric acid to produce a mixture of mono- and di-isopropyl sulfates. The "extract" is hydrolyzed to form the alcohol, which is driven off from the dilute acid solution with live steam.

Crude alcohol vapors are scrubbed with a caustic soda solution to neutralize and remove acidic gases and entrained acid. They are then condensed and put through a finishing system to remove small amounts of ether, water and hydrocarbon materials.

Plant engineers selected several nickel alloys to combat the various acid concentrations encountered. Monel nickel-copper alloy was used for the reboiler and vaporizer bundles (see cut), pressure vessels, neutralizer column, and for trim in pumps, valves, instruments and other equipment. Wide use was made of Types 304 and 316 stainless steel for instruments and pump parts in hydrocarbon service. Compressor liners were of Ni-Resist.

New Coating Selection System

Statistical evaluation and selection of protective coatings is now possible by a system recently developed.

The All-Coat Engineered Coating System permits the selection of optimum type of topcoat, primer and surface preparation specification, which under given environments and contemplated maintenance procedures, results in the lowest maintenance cost for an indefinite time. The basis of the system is a statistical study for the past ten years on various corrosive environments and includes considerations of chlorinated rubber, vinyl, fish oil, alkyd-phenolics, neoprenes, bitumens, phenolics, furanes and the more recent epoxys and isocyanates.

Resultant selection is based on a summation of all factors which affect the total cost of a system including chemical resistance, surface preparation, thickness, labor, aging properties, coverage, cost, and adhesion—which historically have been considered only in an isolated manner.

Further information may be obtained from All-Coat Engineered Coating Systems, 1421 Norman, St. Louis 22, Mo.

Cold Extrusion Of Titanium

Cold extrusion of titanium has been successfully accomplished for the Air Force.

Although only pure titanium has been extruded by the new process, it is hoped this will pave the way for similar work with the more widely-used titanium alloys.

The Air Research and Development Command stated that the cold extrusion process could ultimately permit the manufacture of small titanium parts that would require little machining.

The process is done at room temperature where the highly-active titanium is not contaminated by gases in the atmosphere.

The research project was conducted for ARDC's Wright Air Development Center by Battelle Memorial Institute, Columbus, Ohio.

All cold extrusions to date have been made with simple round bars, and have reduced the cross-section area of the bars by 40 to 70 percent.

This cold extrusion increases the strength of the titanium from 25 to 60 percent, and still permits the metal to be further shaped. In addition, the process produces smooth surfaces on the titanium with close tolerance limits.

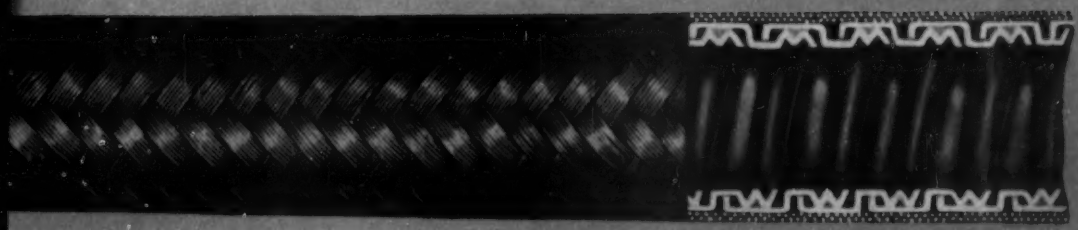
Cold extrusion has been used with steel since World War II, and it permits that metal to be processed with a minimum of machining and with a saving in material, time and facilities. These same advantages could result from cold extrusion of titanium, at the same time sidestepping the metal's surface contamination problems encountered in hot-working operations (above 1,400 F.).

At temperatures of 400 F. and above, titanium is stronger than conventional light metals, yet lighter than steel. Thus, ARDC's new process bridges a gap of strength and lightness. Addition of certain alloying elements strengthens the titanium even more.

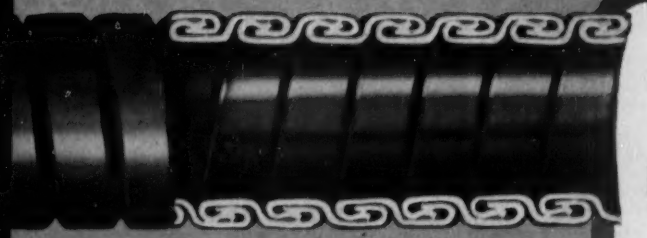
The present physical limits on tools and the pressures involved in the process would restrict cold extrusion to the production of small items only. Large titanium parts can be successfully extruded in the "hot" process.

Equipment for the cold extrusion was designed and constructed for the Air Research and Development Command by Lake Erie Engineering Corp., Buffalo, N. Y.

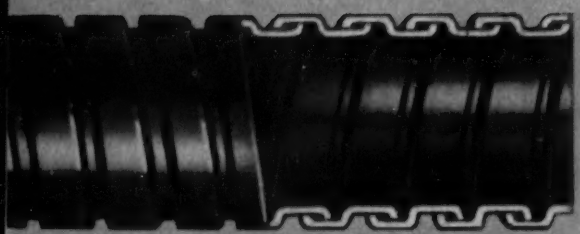
Lt. J. W. Seeger of the Wright Air Development Center Materials Laboratory is the ARDC project engineer on the research work.



TYPE FP WIRE BRAIDED



HEAVY DUTY INTERLOCKED



LIGHTWEIGHT SQUARELOCKED
Unpacked, cord packed, light asbestos packed, heavy asbestos packed

TWIN-LOK
Galvanized Lined
Stainless Steel Lined

PENFLEX

FLEXIBILITY

DEFIES HEAT...FATIGUE ABRASION...LEAKAGE

Penflex is ruggedly built hose with all of the flexibility required, plus the toughness and durability of metal. No matter how hot the material to be conveyed Penflex cannot be cooked like ordinary hose. It stubbornly defies rough abuse, abrasion and crushing.

From 1/8" I.D. to 24" I.D. . . . bronze, galvanized steel, or stainless steel . . . from an air compressor line to a diesel exhaust, Penflex makes them all for the chemical industry. And Penflex "Flexineering"—the science of applying flexible tubing to fit the particular needs of the job to be done—assures the right tube in each installation. When you require tubing or hose that is tight as a pipe, but flexible . . . safe at high temperatures . . . and free from metal fatigue, specify Penflex.

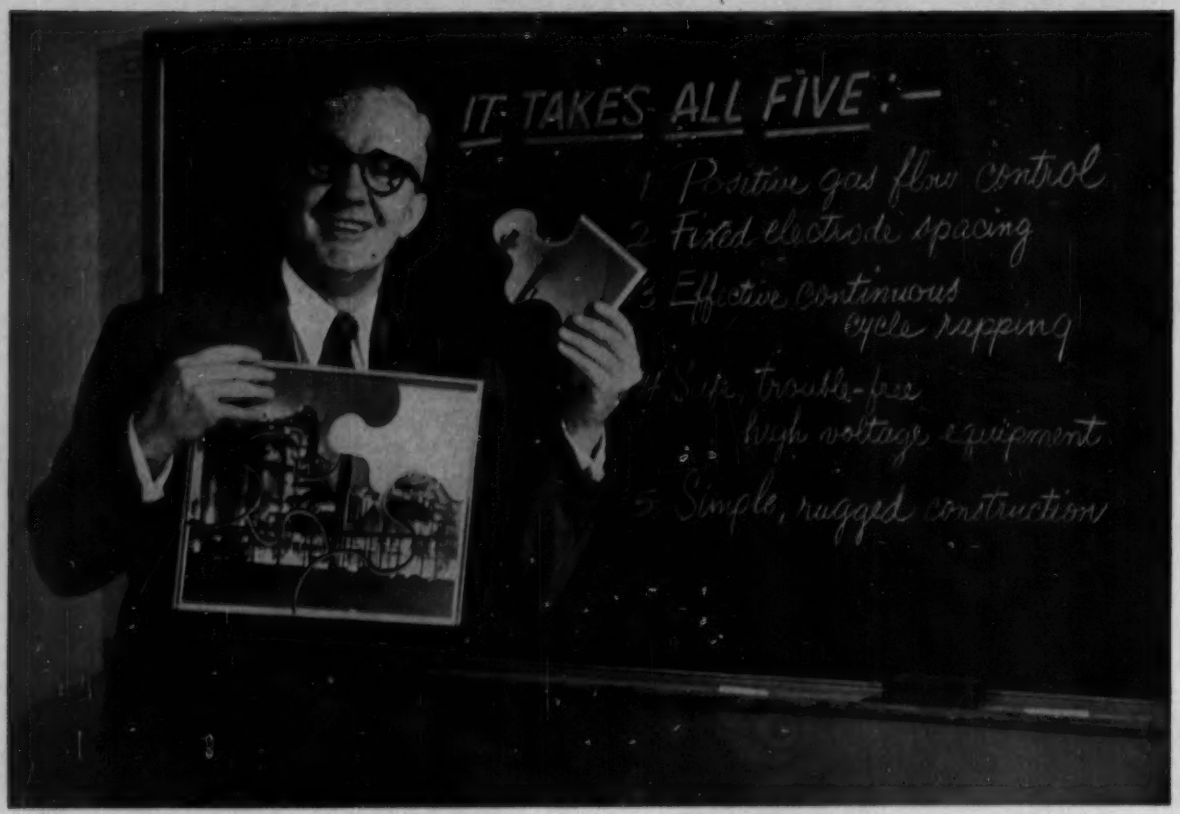
Penflex manufactures a complete line of four wall interlocked and seamless welded corrugated flexible tubing for the chemical industry. Write for your free copy of the booklet "Flexineering At Work."

Pennsylvania Flexible Metallic Tubing Company, Inc., 7234 Powers Lane, Phila. 42, Pa. *Branch Sales Offices:* Boston • New York • Chicago • Houston • Cleveland Los Angeles and Distributors in Principal Cities

HEART OF INDUSTRYS LIFELINES

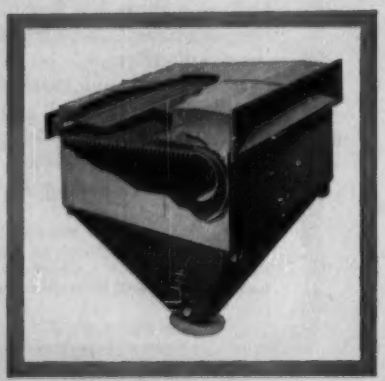
METALLIC TUBING

Buell 'SF' Electric Precipitators meet all 5 basic requirements for TOP EFFICIENCY


IT TAKES ALL FIVE :—
1 Positive gas flow control
2 Fixed electrode spacing
3 Effective continuous cycle rapping
4 Safe, trouble-free high voltage equipment
5 Simple, rugged construction

A slight deficiency of any single factor would be sufficient to impair the performance or service life of any dust recovery system. The constant top efficiency of Buell installations is the result of skillfully adjusting all five elements to best meet various operating conditions . . . provide consistent top efficiency.

Buell Cyclone Collectors are noted for their efficiency, too. Here are exclusive reasons why: shave-off design which harnesses back-flow and puts it to work . . . plus extra large diameter design to prevent "plugging."



Buell "LR" Fly Ash Collectors are ideal for low and high pressure boiler operations up to 2000 BHP, with either natural or mechanical draft. Check them for high efficiency, simple design, compactness, flexibility in layout.

FREE BOOKLET!
"The Collection and Recovery of Industrial Dusts"
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Buell Engineering Company,
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New York 5, New York

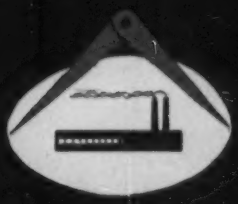
buell

MECHANICAL ELECTRICAL *Experts at delivering Extra Efficiency in* **DUST COLLECTION SYSTEMS**

Using

DU PONT ELASTOMERS

NEOPRENE-HYPALON®



in Industry

Tank linings of HYPALON® for extra-high resistance to oxidizing agents

Long-lasting protection for storage and processing tanks handling some of the *strongest* oxidizing agents is now possible, thanks to tank linings of HYPALON, Du Pont's new synthetic rubber. These are the special applications where severe service conditions justify the use of a special-purpose elastomer coating.

Applied by standard lining methods, resilient linings of HYPALON resist deterioration from such chemicals as chromic acid, sodium hypochlorite and pickling solutions. For the complete list of chemicals to which HYPALON has superior resistance, use the coupon below.

The resistance of HYPALON to chemical attack suits it well for *particularly demanding jobs* in the chemical industry. Its extra-long service life can mean savings in replacement and maintenance in each of these products:

- Acid hose
- Gasket and packing
- Tank linings
- Protective coatings
- Molded parts
- Roll coverings

Other properties of HYPALON include exceptional resistance to heat, complete ozone resistance and resistance to abrasion and flex cracking.

Remember the name HYPALON when a rubber product is needed that must withstand the most severe oxidizing conditions in your laboratory or plant.

THERE IS A LONG service life ahead for this tank section used for storage of calcium hypochlorite. It's lined with HYPALON.

NEOPRENE coatings give 5 years' service in tank cars carrying hot concentrated caustic

WHITE NEOPRENE LINING is sprayed on the interiors of tank cars used to ship hot, concentrated caustic soda.

Neoprene coatings have solved the problem of transporting and maintaining the purity of rayon-grade caustic for the Columbia-Southern Chemical Company, one of the largest caustic-soda producers in the country. Used as a lining in hundreds of tank cars, these durable coatings prevent iron contamination and are giving an average of 5 years' service.

The neoprene linings successfully withstand the attack of 50% and 73% caustic soda shipped at temperatures ranging from 145° F. to 250° F. The linings can be applied in about 72 man-hours, including sandblasting, vacuum cleaning, application of two brush coats of chlorinated rubber primer and 12 to 14 spray coats of neoprene latex resulting in a coating of 20 mils.

The neoprene coatings have served so satisfactorily in tank cars that Columbia-Southern has adopted the same type lining for storage tanks and as a coating for tank-car exteriors.

This is a typical example of how neoprene can reduce maintenance costs. Its service record is also exceptional where exposure to oil, heat, chemicals or weather is a factor. For more information about neoprene used in hundreds of other products such as gaskets, hose, cable or gloves, fill out and mail the coupon below.

DU PONT
REG. U.S. PAT. OFF.

HYPALON *is a registered trademark of E. I. du Pont de Nemours & Co. (Inc.)*

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

Please send further literature and add my name to the mailing list for your free publications, the "Neoprene Notebook" and "Facts about HYPALON®," which show how the Du Pont elastomers are used in improving products and cutting maintenance and replacement costs.

E. I. du Pont de Nemours & Co. (Inc.)
Elastomers Division, Dept. CE-8
Wilmington 98, Delaware

Name_____ **Position**_____

Firm_____

Address_____

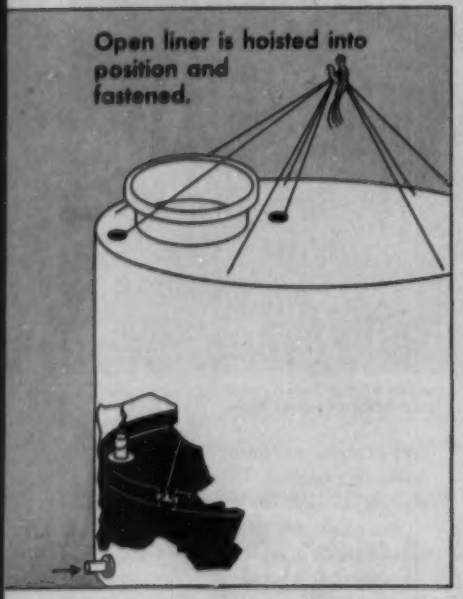
City_____ **State**_____

EDITED BY C. S. CRONAN

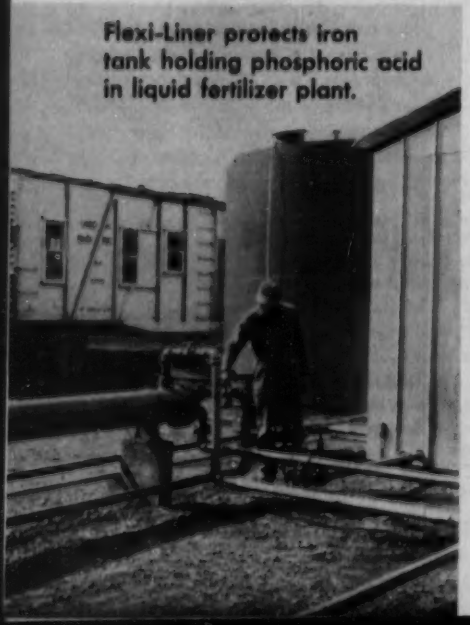
Liner Corrosion-Proofs Tank

Inexperienced plant help can install flexible-plastic liner to protect 500-30,000-gal. tanks against many corrosives. No vulcanizing or bonding needed.

Bundled liner is lowered through manhole into tank.



Open liner is hoisted into position and fastened.



Flexi-Liner protects iron tank holding phosphoric acid in liquid fertilizer plant.

Both old and new steel or iron tanks now can become completely protected against corrosion at low cost through installation of Flexi-Liner (pat. pending) flexible-plastic tank liner. And if a leaky tank is slated for the scrap heap, a Flexi-Liner can be installed to keep the tank in service.

Composition of the plastic bag can be varied to withstand strong or weak inorganic acids and alkalis, strong salt solutions and many hydrocarbons. Used in conjunction with standard black iron construction, it overcomes the need for storing reactive materials in expensive stainless steel, aluminum, glass or lead. Cost savings are indicated in the table, below.

▶**Catching-On Fast**—To date, more than 50 liners have been installed in storage tanks for liquid fertilizers, detergents, chlorine products and industrial ammonia solutions. One application just disclosed is protection of black-iron phosphoric-acid storage tanks in packaged liquid fertilizer plants designed and built by Butler Mfg. Co., Kansas City, Mo. (See cut, lower left.)

Installed cost runs about $600 for a 10,000-gal. liner and approximately $900 for one to fit a 20,000-gal. tank.

Either horizontal or vertical tanks can be fitted with these liners. Development work is proceeding on a liner for transportation tanks.

▶**Bypasses Extra Steps**—Flexi-Liner is a complete container by itself. The tank acts merely as a structure to support and back up the cylindrical plastic bag.

There is no bond between the flexible liner and the rigid tank wall which obviates need for complicated vulcanizing or other bonding processes. Therefore, it is not necessary to sand blast or prime the steel before installing the liner.

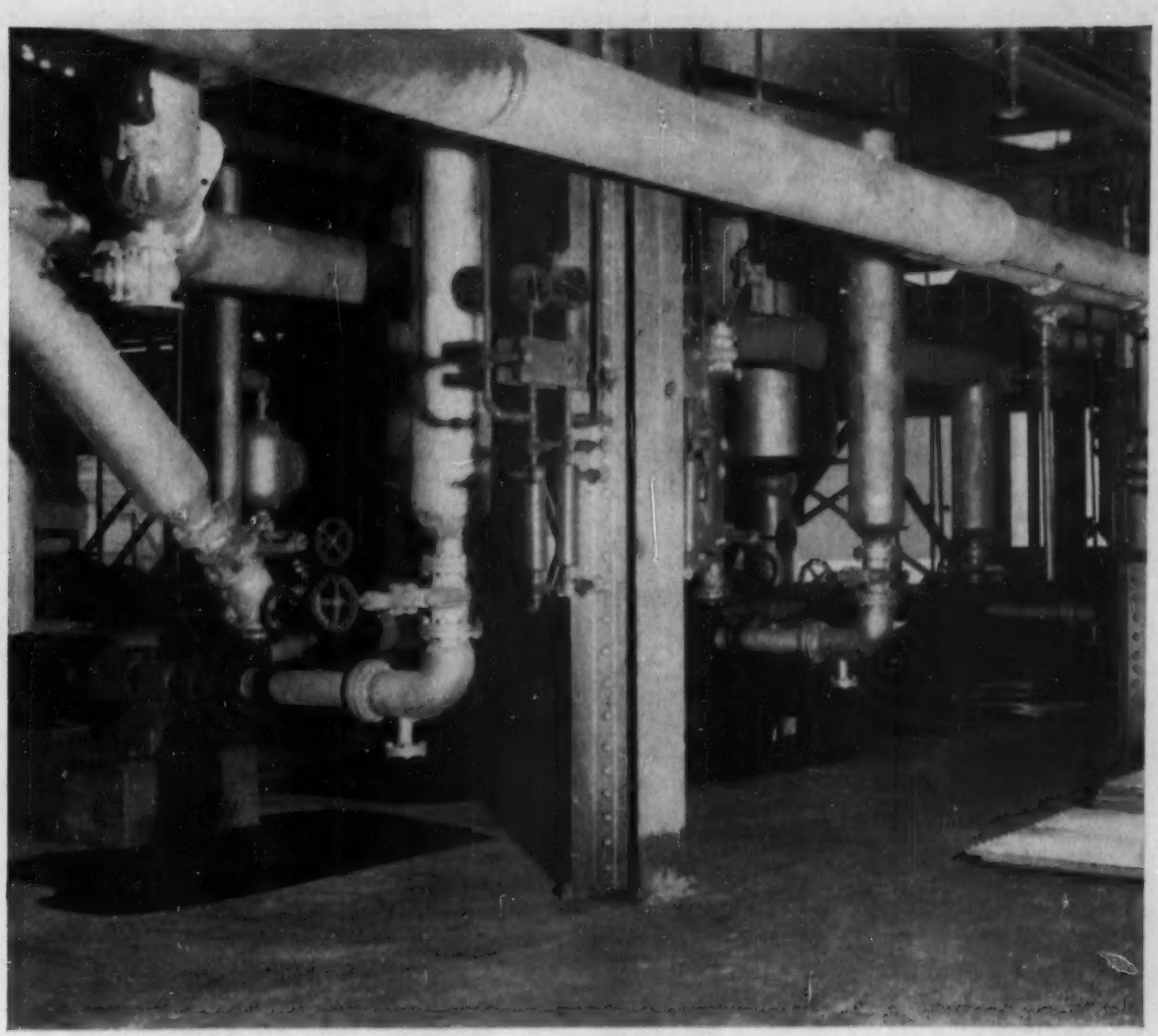
▶**Better Protection** — Flexi-Liner is said to protect tank and contents more completely than coatings. Its laminated construction is thicker and free from pinholes. Freedom from cracking, shrinking, stretching and stiffening are other advantages.

To be sure of complete protection, the user is cautioned to avoid continuous temperatures over 160 F., unless tests have proven that service is satisfactory above this point. Intermittent temperatures up to 200 F. can be tolerated.

▶**Do It Yourself**—Flexi-Liner is shipped to the user as a tightly rolled package. Bundle is passed into empty tank through manhole. Inexperienced plant personnel then can proceed with installation by fol-

Relative Cost of Protected Tanks

Type Tank	10,000 Gal.	20,000 Gal.	100,000 Gal.
Flexi-lined steel	100	100	100
Vinyl-coated steel	112	125	118
Molded plastic	278	273	—
Rubber-lined steel	333	350	304
Lead-lined steel	340	345	304
Glass-lined steel	463	475	446
Aluminum	537	475	—
Stainless steel	602	600	478



Dependably Yours, too!

The men who know—experienced engineers who specify equipment for handling corrosive liquids—usually pick LaBour pumps.

In the large paper mill shown above, LaBour pumps handle the black liquor evaporating process. The designing engineers knew they could depend on LaBour pumps for continual day-in, day-out service with minimum interruption . . . and so can you.

It's this dependable performance and low maintenance cost that has motivated engineers, for the past 30 years, to specify LaBour pumps for their toughest chemical applications. With this enviable and unequalled background, LaBour pumps are the safe choice for your needs, whenever and whatever they might be.

So, take a tip from the experienced . . . don't lose unnecessary "down time" in your plant due to pump failure. LaBour pumps can be Dependably Yours, too.

ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

LABOUR

THE LABOUR COMPANY, INC. • Elkhart, Indiana, U.S.A.

Newsworthy Equipment This Month

Equipment Cost Indexes, p. 264

New Packaging & Handling Equipment

Tank Liner 258A
Shipping Container 260A
Bagging Scale 260B
Multi-Wall Bag 260C

New Electrical & Mechanical Equipment

Dry Bearing 262A
Fuel Conversion Kit 262B
Mechanical Seal 262C
Engine Air Cooler 264A
Roller Chain 264B
Lubricating System 264C
Cable Manhole 264D

New Instruments & Controls

Electronic Load Cell 266A
Pressure Switch 266B
Process Refractometer 266C
Gas Analyzer 266D
Viscometer 266E
Overload Signal 266F

New Processing Equipment

Dry Grinder 268A
Filter 268B
Disperser-Homogenizer 268C
Chlorinator 268D
Floating Cover 268E

New Fluids Handling Equipment

Acid Dispenser 270A
Jacketed Plug Valve 270B
Iron Trap 270C
Water Mixer 270D
Gas Cleaner 270E
Steam Tracing Flange 272A
Tube Fitting 272B
Package Pump 272C
Exhauster 272D

New Heating & Cooling Equipment

Hot Rubber Blanket 274A
Portable Cooling Tower 274B
Heat Exchanger 274C
Finned Coil 274D

Page number is also Reader Service code number

For more details, use Reader Service Card

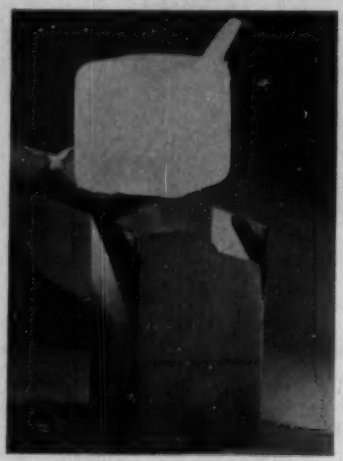
lowing instructions with liner.

First, liner is unrolled on bottom of tank with top side up. Next, semi-rigid polyethylene tubing is inserted in the sleeves which run horizontally around the top and middle circumference and across the top of the liner. Holes in the sleeves, spaced 38 in. apart, permit J-bolt hangers to hook the tubes.

Wires are attached to the eyes of the J-bolt hangers and are passed through holes drilled in the top of the tank. Then the liner is hoisted into position while air is vented or pumped into the liner as it opens up. Fasteners secure the hangers where they extend through the tank wall and top. Inlets and outlets, constructed entirely of plastic, are connected to external lines.—**Flexi-Liner Co., 6 North First St., Arcadia, Calif. 258A**

For More Information...

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.



Shipping Container

Of polyethylene for liquid or powdered chemicals.

Almost any liquid or powder that requires protection from contamination, spoilage, corrosive action or moisture can be shipped, distributed or stored at lower cost in the new Cubitainer.

Designed for one-way shipment, package consists of semi-rigid, cube-shaped insert of polyethylene, and an outer carton of corrugated paperboard. As received, Cubitainer comes knocked down with inserts collapsed and cartons folded.

Conventional packaging equipment can be used to inflate the collapsed insert, set up the carton and assemble these components. Filled by gravity or pressure, the insert is closed by heat sealing the end of the spout which then folds flat as the carton is sealed.

Cubitainer now is available in 1-qt. or 1-gal. sizes; 5-gal. size is almost ready for the market—**Hedwin Corp., 1600 Roland Heights Ave., Baltimore 11, Md. 260A**

Bagging scale, model 700, attaches to feed mixer or hopper, has revolutionary new weighbeam which eliminates loose weights. Will handle paper, cotton or burlap bags at 6 to 8 per min. rate.—**Burrows Equipment Co., 1316-CE Sherman Ave., Evanston, Ill. 260B**

Multi-wall bag has vented tape on ends to speed and clean up packing of aerated materials. Bags pack compactly with more uniform weight.—**St. Regis Paper Co., 230 Park Ave., New York 17, N. Y. 260C**

Why Allis-Chalmers Cooling Coil Design Means . . .

Better Rectifier Operation

More Efficient Heat Transfer results from internal cooling coil. The steel coil surrounds active parts, offering more cooling surface and better heat transfer than other types. Unit maintains more uniform temperature and mercury vapor pressure.

Simplified Maintenance results from Allis-Chalmers unique unit construction. All active components are attached to the anode plate for easy withdrawal, dismantling, and re-assembling — as illustrated above.

Positive Arc Barrier is formed by the cooling coil, which is insulated from the tank. The main arc is confined within the coil, preventing arc transfer to the tank.

Years of Operation in hundreds of installations have proved the reliability, ease of operation, and simplified maintenance of Allis-Chalmers mercury arc rectifiers. You can get complete information at your nearby A-C office, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

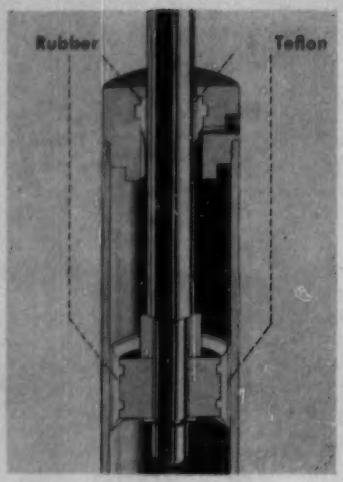
LIVE BETTER ELECTRICALLY

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-5084

Suspension ball joint



Flexible bushing and seal

No Lubricant for New Bearing

For intermittent motion, bearing lined with tetrafluoroethylene-fiber fabric halves friction load, requires no lubrication.

Forerunner of a new type of industrial bearing may be a recently announced automobile suspension joint. Using a Teflon tetrafluoroethylene-fiber facing, this bearing eliminates need for conventional lubrication. Further, compared with standard lubricated suspension joints used in today's automobiles it cuts friction by more than 50%, at no increase in cost.

▶ **What's in the Offing**—This development gives the engineer a new tool to help solve many problems such as lubrication of hard-to-reach parts, operation of frictional parts in extreme temperatures and in corrosive chemical environments. On equipment for processing food and drugs it overcomes the problem of contamination from lubricants, eliminates or reduces preventive maintenance, downtime and replacement of parts.

Right now, development is proceeding on frictional applications, other than automotive suspension systems, where it may be possible to eliminate conventional lubrication. Among these are:

- Spherical parts such as rod ends and ball-socket joints for special controls and self-aligning bearings.
- Cylindrical parts such as seals, bushings, pistons and sleeve bearings for all types of machinery.
- Flat or sliding parts, such as leaf-spring end pads and slider beds for adjustable seats and conveyor belts.

▶ **No Panacea**—Despite its potential, Teflon-fiber fabric is not expected to be used in bearings universally. For example, bearings of nylon or tetrafluoroethylene resins will do many jobs better and cheaper. Also, conventional lubrication still looks better for bearings subjected to continuous motion in one direction at high speed and load.

▶ **Suspension Joint**—In the ball and socket suspension joint the Teflon tetrafluoroethylene fiber is double woven with a backing of nylon or cotton. This fabric is laminated to cotton-reinforced phenolic resin and formed into a cup which lines the socket. Metal parts are coated with a special grease to prevent damage from corrosive conditions.

When the joint is assembled, it molds the preformed bearing to assure a perfect spherical contact between the ball stud and the bearing. Then, the joint is sealed. Preliminary testing indicates that these bearings will last the lifetime of the automobile, without lubrication or other maintenance.— **American Metal Products Co., 5965 Linsdale St., Detroit 4, Mich.** 262A

Conversion Kit

Changes lift trucks over to operation on LP gas fuel.

Using a new pre-assembled kit, you can convert any make of industrial lift truck to operation on LP gas fuel within three or four hours. Some industrial users of lift trucks have claimed to save up to 40% of operational costs by converting to this fuel.

All lines, fittings and carburetion assembly are mounted for bolt-on arrangement. Parts are sized to fit any model, make, shape or size of truck. Kit comes complete with fuel cylinder bracket, toggle and strap to hold cylinder in position and location pin to carburetion linkage.

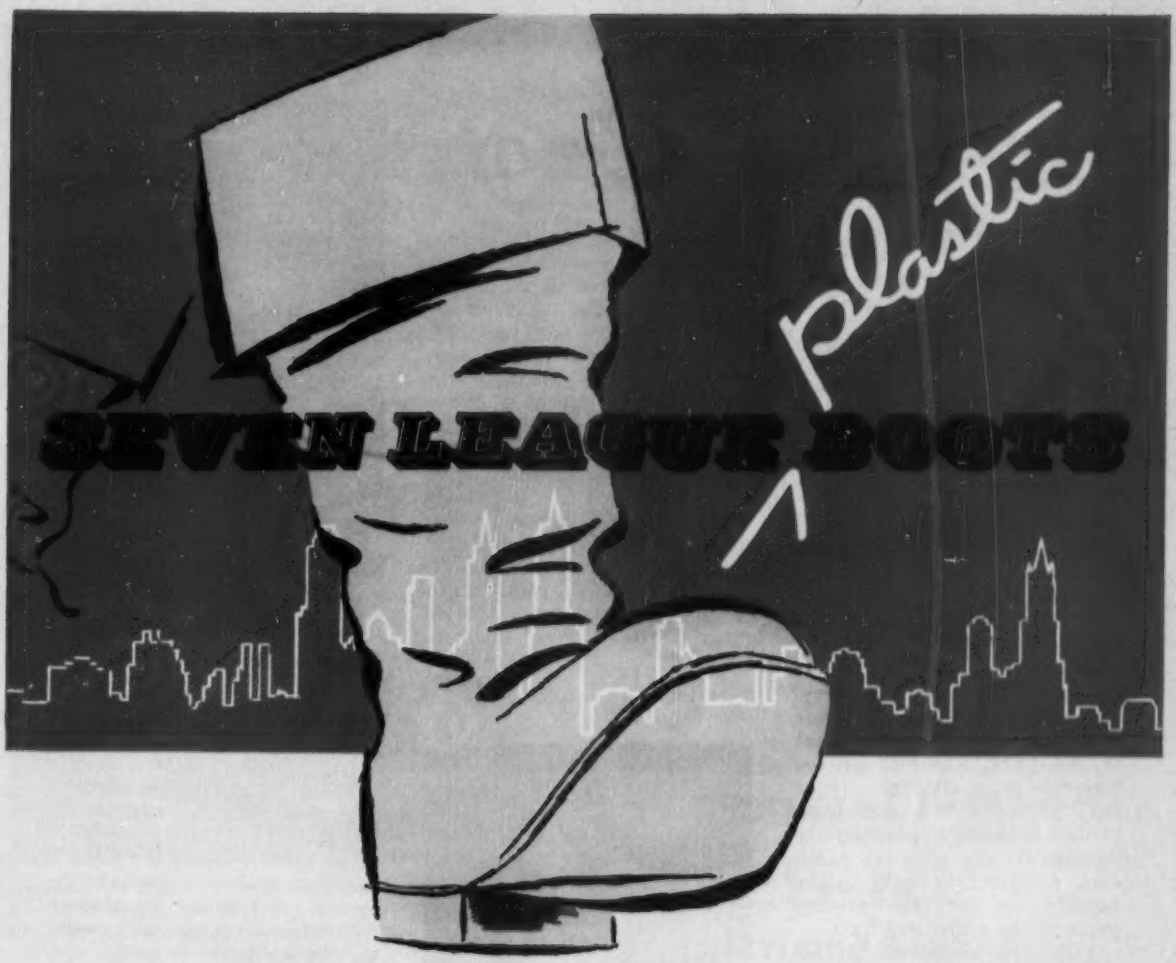
Underwriters' Laboratories and insurance underwriters have approved the kit completely.— **Industrial Gastruck, Inc., 2019 Dempster St., Evanston, Ill.** 262B

Mechanical Seal

Built with improved facing material for handling chemicals.

Recommended for all chemical service other than hot strong caustics and some fluorine compounds, No. 55 facing for mechanical seals is a wear-resistant, highly refractory coating of pure oxides. This new material is highly resistant to thermal or physical shock and corrosion. It seals with a very low coefficient of friction at the contact surfaces.

Material was developed with



In giant strides the plastics industry moves forward . . . developing, producing, improving a multiplying array of products to meet the ever-growing demands of the buying public.

Escambia Bay Chemical Corporation took its first step in true "seven-league" style . . . moving in a matter of months from paper plan, through plant construction, to production of its first family of products – ammonia, nitric acid and nitrogen fertilizer materials.

At our 2000-acre site on Escambia Bay near Pensacola, Florida, our POLYVINYL CHLORIDE RESINS plant, now under construction, will go "on stream" before the end of 1956 with an annual capacity of 30 million pounds.

With this step, Escambia Bay Chemical Corporation joins the forward march of a fast-moving, dynamic industry.

ESCAMBIA BAY CHEMICAL
CORPORATION
261 MADISON AVENUE • NEW YORK 16, N. Y.

the cooperation of the Norton Co., Worcester, Mass., and is available on Dura Seals. It can be applied to existing rods, shafts or sleeves used with conventional packing. Parts must be shipped to Durametallic's Kalamazoo plant for application of the No. 55 facing.—**Durametallic Corp., 2104 Factory St., Kalamazoo, Mich. 262C**

Engine Air Cooler

Cuts top cylinder wear of heavy duty engines.

Dust laden plant air is reported to be no threat to engine life when intake air is filtered through the new PurOlator dry-type Micronic air filter. Better than 99% removal of dirt has been proven in all engine speed ranges.

Micronic filters are made with convoluted cellulose that cannot pack, separate or deteriorate even after months of hard service. Porosity is controlled to make impossible the passage of any abrasive particles sufficiently large to be harmful to the vital moving parts of the upper engine.

Filter can be replaced in less than a minute. Element can be cleaned by applying a reverse flow of low-pressure air.—**Purolator Products, Inc., 970 New Brunswick Ave., Rahway, N. J. 264A**

Equipment Cost Indexes

Industry	Dec. 1955	Mar. 1956
Avg. of all	196.9	201.3
Process Industries		
Cement mfg.	188.8	192.5
Chemical	198.1	201.9
Clay products	183.4	187.0
Glass mfg.	197.1	190.7
Paint mfg.	190.6	194.3
Paper mfg.	190.9	194.6
Petroleum ind.	194.5	198.3
Rubber ind.	197.0	200.8
Process ind. avg.	194.6	198.4
Related Industries		
Elec. power equip.	199.9	203.8
Mining, milling	199.3	203.2
Refrigerating	219.0	224.9
Steam power	186.6	190.2

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See *Chem. Eng.*, Nov. 1947, pp. 124-6 for method of obtaining index numbers; March 1956, pp. 194-5 for annual averages since 1913.

Roller Chain

Is non-corroding, yet costs 40% less than stainless steel.

Developed to satisfy industrial requirements where corrosion resistance is an important factor, the electrolyzed roller chain costs 40% less than stainless steel chain.

Tensile strength of the chain is greater than that of stainless chain and equal to alloy chain. Because electrolyzing makes the surface smooth, wear is cut to a minimum and life is longer.

Made in all Standard American Roller Chain sizes, the new chain is said to meet and beat all of the accepted roller chain specification standards.—**Atlas Chain & Mfg. Co., West Pittston, Pa. 264B**

Lubricating System

Centralized type operates at temperatures up to 500 F.

Fully automatic lubrication at temperatures up to 500 F. is provided by new centralized lubricating systems.

Newly designed valves and filters combine heat resistance with required filtration and flow control characteristics. Special lubricants have been developed for use with the high-temperature systems.

Most of the manufacturer's line of cyclic, continuous and "one-shot" centralized lubricators can be furnished with the special features for high-temperature service.—**Bijur Lubricating Corp., Rochelle Park, N. J. 264C**

Cable Manhole

Located above ground, overcomes shortcomings of conventional type.

Keep your electrical personnel above ground and avoid trouble. The new type GUB above-ground manhole condulet provides a simple, inexpensive means for splicing main electrical feeder cables and making branch taps.

With type GUB, you avoid dealing with gas contamination or accumulated water so often found in underground manholes. It is equipped with breathers and drains to reduce internal condensation. And there is no need to fill the interior with hot insulating or waterproofing compounds.

Manhole is available in styles for either ordinary or hazardous locations. Installed singly or in groups, the new condulets accommodate the same number of feeders and branches as below-ground manholes, at one-fourth the cost.—**Crouse-Hinds Co., Wolf & Seventh North Sts., Syracuse 1, N. Y. 264D**

For More Information...

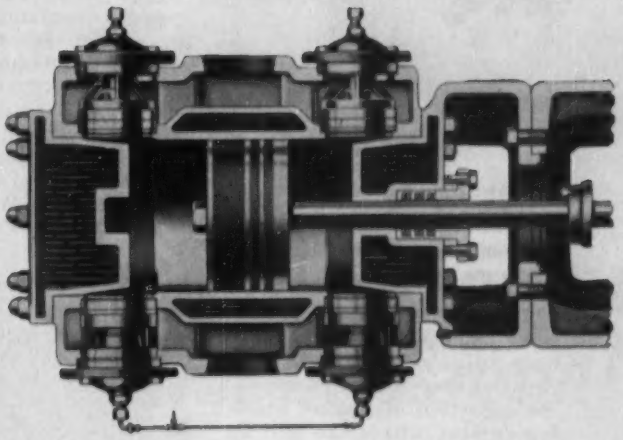
about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

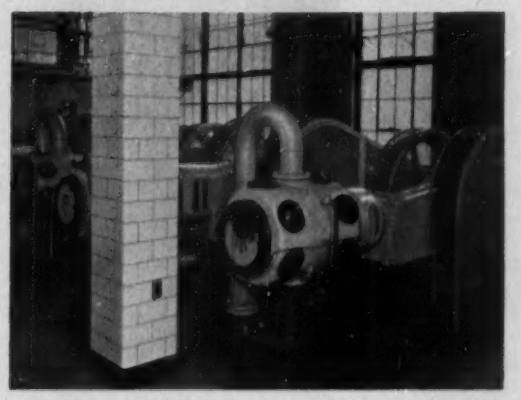
A dependable supply of

oil-free air or gas

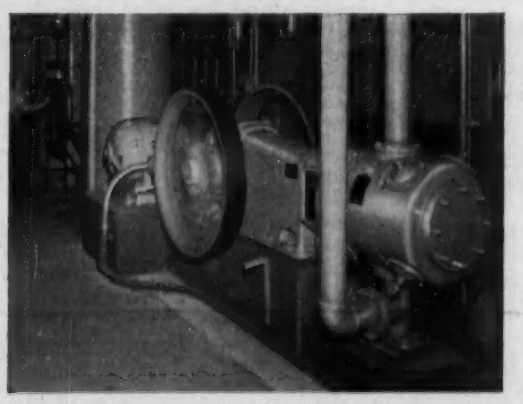
Graphitic-carbon wearing rings and pressure rings prevent metallic contact between the piston and cylinder bore—no oil is used anywhere in the compression cylinder or on the piston rod.

NL Channel Valves are designed specifically for non-lubricated service. Carbon guides protect channel ends and special Teflon strips protect channel interiors and spring ends from metal-to-metal rubbing and wear.





Installed in a large brewery in 1933, this Ingersoll-Rand ES-NL compressor was the first unit ever built with non-lubricated cylinders. It is still in daily service, providing the clean, oil-free compressed air which is vital to product purity. Three other ES-NL compressors, installed since then, are shown in the background.



One of four ES compressors with NL cylinders, supplying oil-free air in the manufacture of super-precision instruments and aircraft ball bearings.

with Ingersoll-Rand

ES-NL

compressors

In process and manufacturing plants all over the world, the problem of oil contamination in compressed air and gases has been successfully solved by the application of Ingersoll-Rand ES-NL compressors.

The unique NL cylinder design provides compression without oil lubrication—through the use of graphitic-carbon wearing and pressure rings. The ability of these compressors to deliver clean, oil-free air and gas, in continuous, heavy-duty service, has been thoroughly proved in every field of application.

If you have an application where oil-lubricated compressor cylinders cannot be used, ask your Ingersoll-Rand representative about the ES-NL compressor, sizes 5 to 150 horsepower—other Ingersoll-Rand NL compressors to 1000 hp.

Ingersoll-Rand

1-422 11 Broadway, New York 4, N. Y.

COMPRESSORS • CONDENSERS • AIR & ELECTRIC TOOLS • PUMPS • ROCK DRILLS • GAS & DIESEL ENGINES

Electronic Load Cell

For low-cost industrial systems to measure weight or force.

An electronic load cell now being applied to industrial systems relies on a magnetic air-gap transducer that measures the deflection of a steel bending member within the cell. It can be used on portable wheel scales, built-in wheel suspension systems, fork lift trucks, permanent scales, etc.

Cell can tolerate extreme overloads up to 1,200% without affecting the calibration. Although measuring only 1.6 in. tall for a 10,000 lb. capacity unit, it has an output over 3 v. so that no amplifier is needed. Since it operates by null balance, the system is relatively impervious to variations in voltage, frequency or wave shape.

Cells of all capacities in the range from 500 through 10,000 lb. sell for approximately $60; indicators are in the range from $140 to $172.—**Ball Bros. Co., Inc., Controls Cells Div., Muncie, Ind.** 266A

Pressure Switch

For wide variety of controlled pressure and limit switch applications.

A new industrial-gas pressure switch has been designed to satisfy Factory Mutual requirements for a safety cutoff switch on multiple-burner gas installations. Also, it can be used as a pressure controller for hazardous gases, or as a differential pressure controller in non-hazardous gases.

Switch consists of a mercury switch actuated by a non-metallic (Buna N) diaphragm through a lever mechanism. Over the diaphragm is a sealed and tapped pressure chamber which prevents passage of gas or system fluid to the switch compartment or atmosphere if the diaphragm ruptures.

All adjustments are inside the case to avoid careless or accidental manipulation. Yet, the entire cover of the switch is a window to permit noting the position of the switch and the scale.—**Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Ave., Philadelphia 44, Pa.** 266B

Process Refractometer

Mounts directly on process stream for continuous monitoring.

An industrial process refractometer, now available, continuously measures the difference in refractive index between a flowing liquid sample and a reference liquid. Variations in the stream can be detected in very short order and the necessary changes made to bring the product back to standard.

Features of instrument include a sealed optical system, photocell detection, temperature compensation and a null-balancing system for maximum accuracy. Sample cell is readily accessible and results may be read directly from a dial or a remotely located recorder.

Instrument is built in three models with ranges of limiting sensitivities covering 0.0001, 0.00001, 0.000002. Accuracy is better than ±0.5%. — **Barnes Engineering Co., 30 Commerce Rd., Stamford, Conn.** 266C

Gas Analyzer

Using thermal conductivity, measures gas stream.

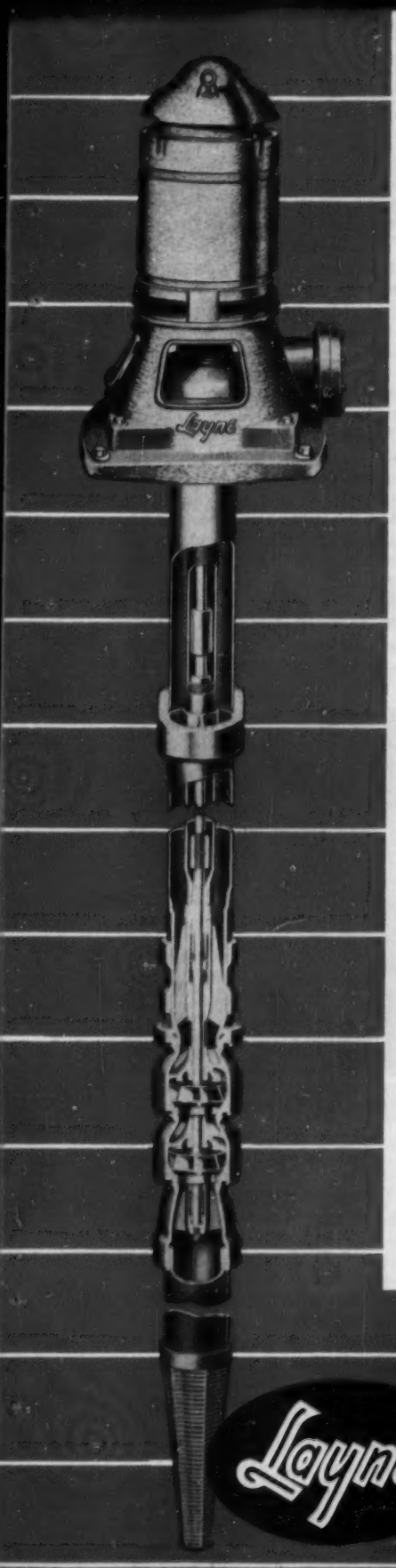
Recent addition to a line of advanced instruments is a thermal conductivity type of gas analyzer. It can measure process stream gases such as carbon dioxide, hydrogen, ammonia and many others.

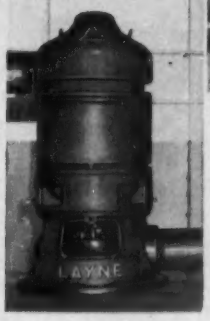
Instruments are designed individually to meet the particular requirements of an application. Most components are standard but specially designed ones are available.

Flexibility of construction is said to make these instruments applicable to a wide variety of gas analysis problems, yet satisfy individual plant needs. With this specialized attention, the accuracy, response and stability of the analyzer are said to be optimum for the application.—**Arnold O. Beckman, Inc., 1020 Mission St., South Pasadena, Calif.** 266D

Brookfield viscometer now available in explosion-proof construction. All models have been thoroughly field tested and approved by the Underwriters' Laboratories.—**Brookfield Engineering Labs., Inc., Stoughton, Mass.** 266E

Overload signal warns driver of industrial truck that the load on the truck exceeds the safe operating capacity of the truck. Also, warns when load is dangerously unbalanced.—**Lamson Mobilift Corp., Syracuse 1, N. Y.** 266F





Tires by Firestone Water by Layne!

The largest single factory in the Firestone organization producing tires and tubes is the Memphis plant. And the enormous quantities of steam used in modern tire production need an assured supply of thousands upon thousands of gallons of water.

Layne of Memphis was selected by Firestone of Memphis to engineer, equip and install the water system now used to service this largest of all Firestone plants.

The blue chip industries of America, and the smaller industries as well, know the wisdom of relying on Layne for all phases of ground water development.

LAYNE
& BOWLER, INC.
MEMPHIS
General Offices and Factory

LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

Layne

Water Wells · Vertical Turbine Pumps · Water Treatment

Dry Grinder

For micron range, is a modification of previous design.

A new model of the Micronizer dry grinding machine offers distinct advantages where separate filtering, drying and grinding steps can be combined into one operation. Solids containing up to 30% moisture have been dried, ground and classified in one operation. Materials which may be harmed by conventional drying methods can be processed without harm in the Micronizer because hold-up time is short.

The Micronizer uses jets of compressed air or steam to rotate particles at high speed within a shallow grinding chamber. Through violent impact, the particles tend to pulverize each other.

Seven sizes of the unit are offered with capacities up to 3,000 lb. per hr.—**Sturtevant Mill Co., 103 Clayton St., Boston 22, Mass.** 268A

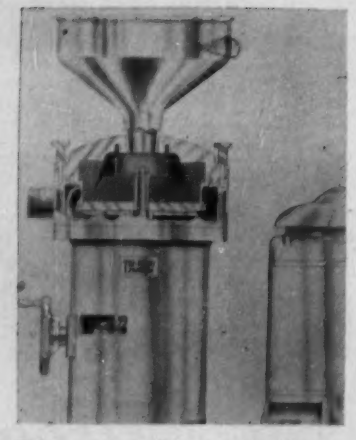
Filter

Designed to meet the requirements of modern plant processing.

The manufacturer of the new IWF industrial filter has incorporated a number of features aimed at improved flexibility and performance.

For instance, there is efficient high-flow backwash which eliminates disassembly for cleaning; choice of five basic sizes in numerous arrangements of multiple units on both sides; four different filter elements to provide a suitable septum for most process needs; high-polish, diatomite filtration with or without continuous body feed; batch or fully continuous on-stream operation; and ASME construction.

To achieve the high flow backwash, a head of compressed air is developed in the high dome of the filter shell. When the backwash valve is opened, the backwash liquid is driven through the filter elements in the reverse direction.—**R. P. Adams Co., Inc., 307 East Park Dr., Buffalo 17, N. Y.** 268B



Disperser-Homogenizer

With stone-type rotor and stator is designed for long life.

The new Pioneer all-purpose mill and homogenizer is reported to culminate 25 years of achievement in the field of wet milling, particle size reduction or homogenization to the small or micron range of particle size. Machine usually is furnished with porcelain or ceramic rotor and stator which give high throughput rates and exceptional particle fineness.

Rotor and stator are provided with patented abrasion-resisting wear rims to prevent erosion of the edges of the stones and increase stone life greatly. Clearance between rotor and stator has micrometer adjustment. Rotor speed is regulated to avoid overheating and reduce power consumption. Also, the head is water jacketed to control temperature.

Other features include a rotating trap basket at the feed inlet, gravity feed and ability to discharge against backpressure. Machines furnished complete with motor for production rates from 5 to 5,000 gal. per hr.—**Tri-Homo Corp., 100 Highland Ave., Salem, Mass.** 268C

Chlorinator

Employs new variable orifice to control flow of chlorine.

Built entirely with corrosion-resistant materials the first two models of a new line of chlorinators feature a new V-notch variable orifice and control. With this control there is wide-range adjustment of chlorine flow, excellent reproducibility of flow by simple adjustment and uniform accuracy over entire wide flow range.

Variable orifice is constructed by mounting an orifice ring inside a cylindrical chamber through which the chlorine flows. A cylindrical plug that fits the orifice closely is positioned so that it can be moved back and forth in the ring. A tapered V-shaped groove in the plug acts as the variable orifice for passage of the gas. A constant differential pressure across the orifice assures that flow will vary only with a change in orifice area.—**Wallace & Tiernan, Inc., 25 Main St., Belleville 9, N. J.** 268D

Floating Cover

Layer of plastic pillows, cuts liquid loss from tank.

Evaporation from open tanks and vessels is reduced as much as 70% and solution life is increased by newly available polyethylene pillows. A 1½-in. layer of these tiny air-inflated pillows retards evaporation.

Pillows are ¾-in. O. D. by 1¾ × ¾ in. They have virtually unlimited life, are resistant to most chemicals and allow access into the liquid.

An initial production run of 833,000 pillows already is in use at the atomic energy facilities in Oak Ridge, Tenn.—**American Agile Corp., P. O. Box 168, Bedford, Ohio.** 268E

DU PONT

Better Things for Better Living ... through Chemistry

CHEMICAL ENGINEERING NEWS

PROPERTY AND APPLICATION DATA ON THESE VERSATILE ENGINEERING MATERIALS: "ZYTEL," "ALATHON," "TEFLON," "LUCITE."

Ball valve seals of molded TEFLON® are chemically inert... withstand extreme temperatures and pressures

Gaskets and packings of chemically inert TEFLON® are tough and heat-resistant

The opportunities for improved performance that TEFLON tetrafluoroethylene resin offers the chemical field is without parallel. Its use in process equipment saves money through reduced maintenance; lowered replacement costs; increased productive capacity (because of less downtime); reduced wear on piston, shafts, etc.; and simplified design. TEFLON may improve the quality of the product by eliminating contamination. In many instances, TEFLON has been found to be the only material that would give satisfactory performance.

Gaskets and packings of TEFLON provide exceptionally long life, which lowers maintenance, and cuts replacement costs and downtime. Because of the low-friction characteristics of TEFLON, the torque required to turn shafts or stems is minimized.

In addition to its use in gaskets and packings, TEFLON gives exceptional performance in such items as valve seats, discs, diaphragms, bearings, pipe and fittings.

MOLDED BALL SEALS of Du Pont TEFLON provide tight, long-lasting, chemically inert seals. This valve controls air flow in North American Aviation Corporation's F-86. Valve manufacturer is Koehler Aircraft Products Company, Dayton, Ohio; fabricator of the ball seals of TEFLON is Sparta Manufacturing Company, Dover, Ohio.

The unique combination of properties of TEFLON tetrafluoroethylene resin permits a practical and economical handling of fluids at high temperatures and pressures. In motor-operated valves, manufactured by the Koehler Aircraft Products Company, Dayton, Ohio, two ball seals of TEFLON provide a leak-proof seal, even when subjected to temperatures from –65°F. to 400°F. and pressures as high as 350 psi.

These seals of TEFLON retain their original size, whether they are in constant contact with hydraulic fluids, or water, air, and other elements which could cause swelling in ordinary materials. The extremely low coefficient of friction of TEFLON enables the ball to rotate easily within the two seals, opening or closing the valve.

TEFLON is chemically inert. It is suitable for use within the temperature range of –450°F. to 500°F. It is resilient and tough. This combination of properties recommends its use for diaphragms, seals, gaskets, packings and filters. Since TEFLON is unaffected by corrosives, its use greatly enlarges the range of materials a given piece of equipment can safely handle.

If your problem involves extremes of temperature and highly corrosive chemicals, a further look into the properties of Du Pont TEFLON may very well provide your answer. Clip the coupon below for complete property and application data.

SEND FOR MORE INFORMATION

For complete details that will help you further evaluate Du Pont TEFLON for use in your product-development programs, mail the coupon at the right. Specific property and application data will be sent to you.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department
Room 258, Du Pont Building, Wilmington 98, Delaware
In Canada: Du Pont Company of Canada Limited, P.O. Box 660, Montreal, Quebec

Please send me complete property and application data on Du Pont TEFLON.

I am interested in evaluating this material for

_____

_____

Name _____

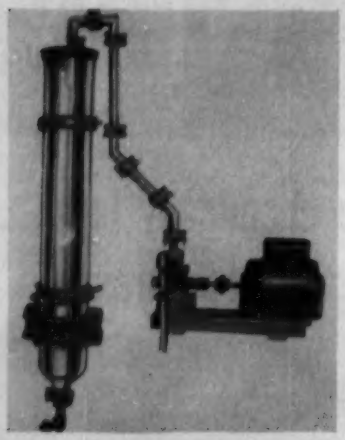
Firm Name _____

Position _____

Type of Business _____

Street Address _____

City _____ State _____



Acid Dispenser

Delivers measured amounts of acid to carboys or drums.

With an acid pump, now available, you can pump a measured amount of acid into a glass reservoir, then drain by gravity into carboy or drum.

The positive-displacement chemical pump has Teflon fins, will discharge from ¼ to 11 gpm. Size of glass reservoir can be chosen to meet requirements of application. An electronic float control is provided.

Unit can be engineered to specification so that top performance is attained despite relative location of pump and reservoir.—**Electro-Graphic Co., 215 First St., Cambridge 42, Mass.** 270A

Jacketed Plug Valve

Redesigned for operation with worm gear.

Optional operation with worm gearing now is offered on a line of jacketed 2- and 3-way plug valves for 3- to 8-in. lines. Value of the gear operation has been increased by redesigning the standard valve.

Among the new features are: deeper stuffing box to accommodate more packing for better sealing; thrust ball on which plug rotates with screw to adjust seating of the plug in the body; raised jacket tappings to permit use of street elbows, eliminating use of elbow and nipple.

The gear operators have stops at 90 and 180 deg. Indicators on gear and top of plug show position of port openings in relation to body.—**Parks-Cramer Co., Fitchburg, Mass.** 270B

Iron Trap

Sanitary model for liquid processing lines.

Recently added to the line of Ferrotrap, permanent, non-electric magnetic separators is new model LS sanitary Ferrotrap. Installed in liquid processing equipment it prevents fine iron from contaminating product and tramp iron from damaging machinery.

Model LS is a sanitary adaptation of model L which contains one highly efficient, Type 304 stainless-steel-encased Alnico V permanent magnetic tube. Tube and cover plug are a single unit which may be removed for cleaning by simply unscrewing the cover. Operating efficiency is unimpaired by the installed position of the trap.

Three different classes of LS Ferrotraps cover a range of liquid viscosities.—**Eriez Mfg. Co., Erie 6, Pa.** 270C

Water Mixer

Controls temperature of process water within close limits.

Fool-proof control of water temperatures is reported for a newly designed control unit, the type N Hydroguard. Not only is this thermostatic mixer more compact and accurate than previous models, but it even guards against its own failure.

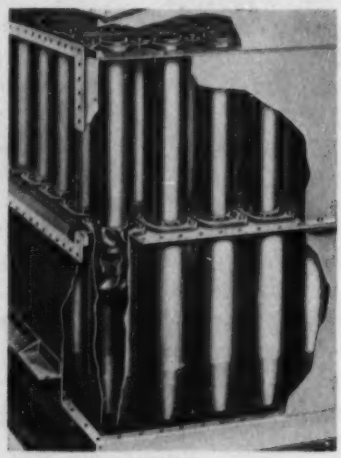
If either hot or cold water supply fails, the Hydroguard automatically closes the other port. Should the thermostatic liquid-filled motor itself fail, a fail-safe provision closes the hot and cold water poppets.

Accuracy of the mixer holds temperature of discharge water within ±2 deg. despite a 75% drop of inlet pressure, a 45-deg. fluctuation in hot water supply temperature, or an 85% restriction of discharge flow.

Type N Hydroguard is available in 45 or 125 gpm. capacities. It will deliver water at any temperature between 65 and 115 F. An 85-160 F. range can be furnished on special order.—**Powers Regulator Co., 3434 Oakton St., Skokie, Ill.** 270D

For More Information...

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.



Gas Cleaner

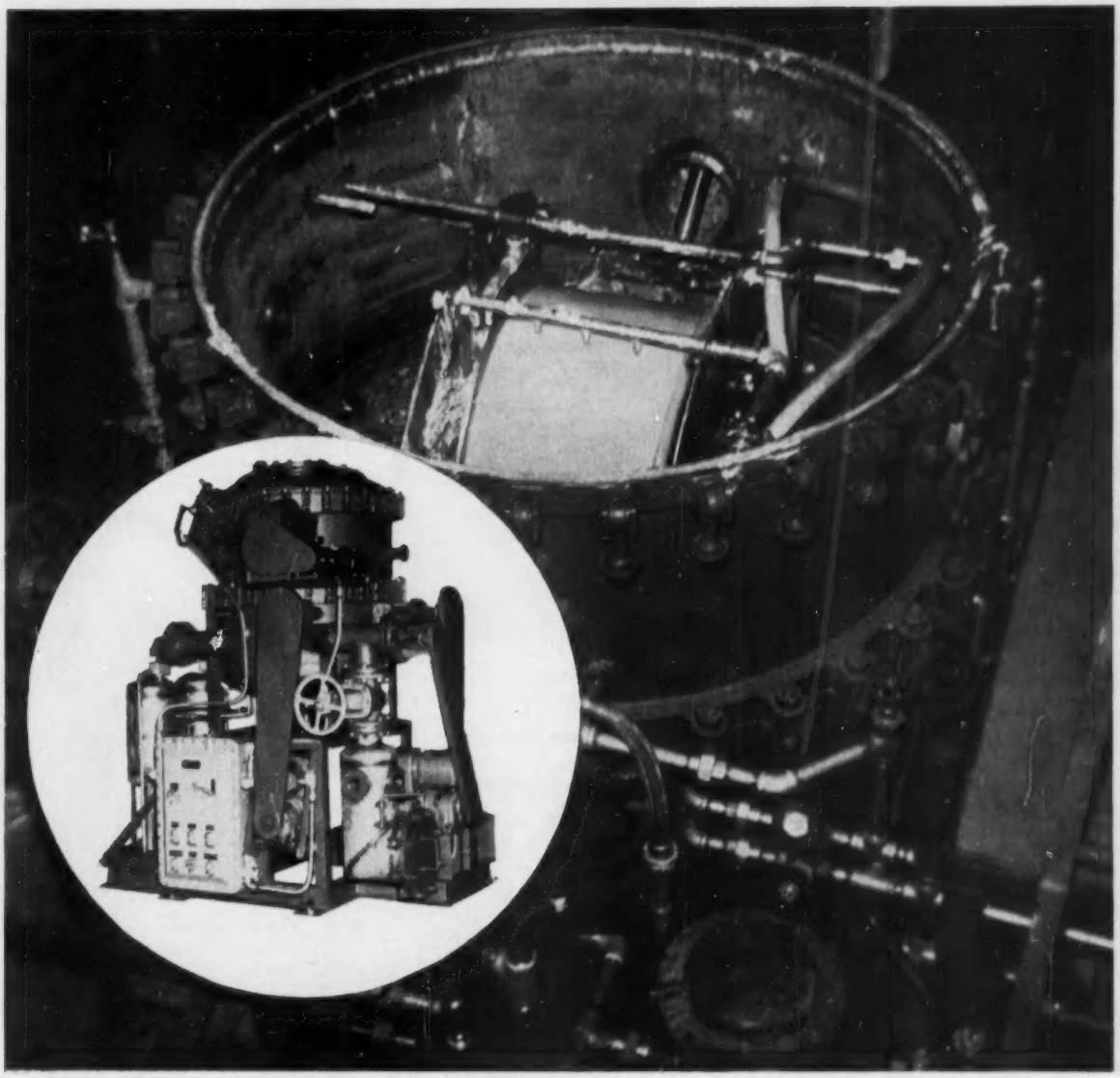
For given pressure drop, higher efficiency and flow.

Aerodynamic principles applied to gas flow enable the Cyclo-trell mechanical collector to operate with fewer tubes per unit at a lower total cost for a given capacity and efficiency.

Cyclo-trell depends on centrifugal force generated in a bank of parallel cyclone tubes to remove suspended solids from flowing gas. Gas entering the chamber from the left (see cut) flows into the lower large-diameter tubes.

The airfoil inlet vanes direct the gas into a tight spiral with minimum turbulence. With faster spin, centrifugal force increases to boost the drop-out and collection efficiency.

Cleaned gas is forced toward



WE CAN'T SEND A SAMPLE

Eimco's Research and Development Center has the answer for the plants with difficult filtration problems. The engineers at the Center know that under certain product conditions it is unwise for the laboratory to try to reproduce plant conditions in which the sample was taken.

The alternate is to provide test equipment at job site suitable for wide range filtration problems. Eimco has designed several units similar to the unit shown above that can be used as standard drums, precoating drums, pressure drums and pressure precoating drums. These units are also equipped for washing and can use several types of cake removal attachments.

Eimco's experience in over half a century of service to process industries has given them the advantage of understanding filtration problems. The need for developing and producing numerous types of filtration equipment gives Eimco more opportunity to serve the customer's needs.

Eimco's objectives are: 1. To solve the customer's filtration problem successfully. 2. To recommend the most practical and economical equipment suited to the job, and, 3. To give a stand-by consulting service in securing maximum benefits from the equipment.

Yes! When you have a problem in filtration, Eimco can help whether or not you can send a sample.

THE EIMCO CORPORATION

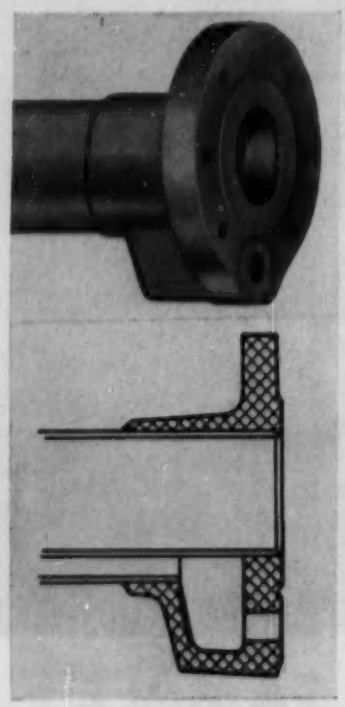
Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Baltimore, Md. Pittsburgh, Pa. Seattle, Wash. Pasadena, Calif. Houston, Texas Vancouver, B. C. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

B-197

the center of the tubes and then upward through energy-recovering outlet vanes and into the smaller diameter outlet tubes. Vanes at the entry of the outlet tubes increase the capacity, thereby decreasing the number of tubes needed per unit.

Shell and hopper of the Cyclo-trell are 7-gage bolted steel. Inlet tubes and vanes are cast iron to resist the abrasive action of dirty entering gas.—**Research-Cottrell, Inc., Bound Brook, N. J.** 270E

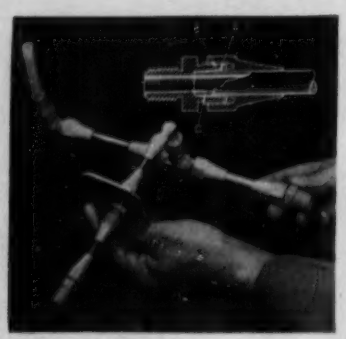


Steam Tracing Flange

Joins extruded steam-traced aluminum pipe.

A new cast flange has been introduced for joining sections of Unitrace pipe simply and efficiently. Unitrace, announced by Alcoa two years ago, is an integrally extruded steam-traced aluminum pipe. The flange has a built-in steam tracing line. This prevents product from freezing in the space between Unitrace sections.

To join two sections of Unitrace, the trace lines are cut back approximately 2½ in. from the ends of the sections to be joined. Then, the flanges are slipped onto each section end. Unitrace sections and flanges are joined by welding at the front faces and necks of the flanges using 4043 weld wire.—**Aluminum Co. of America, 1501 Alcoa Bldg., Pittsburgh, 19, Pa.** 272A



Tube Fitting

Two-piece plastic fittings require no flaring, are re-usable.

Fabricated from DuPont's nylon resin, Zytel, this complete line of fittings is intended for both metal and plastic tubing of ⅛ in. through ½ in. O.D.

Because of its simplified two-part design the fitting need not be flared nor the tubing "necked" or cut to an exact length for leak proof connections. Consequently both tubing and fittings can be re-used.

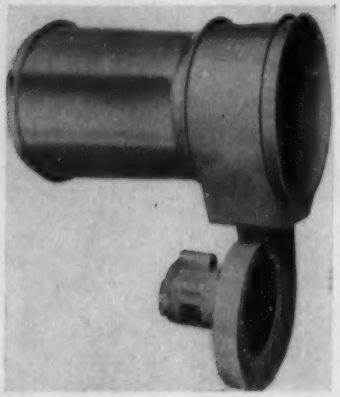
Zytel, a nonconductor, resists electrolytic corrosion. It is 1/17 the weight of brass yet able to withstand pressures up to 500 psi. Fittings of this resin will survive temperatures from −70 F. to +295 F. With corrosion resistance equal to stainless steel the material is impervious to the attack of acids or alkalis.—**Jaco Mfg. Co., P. O. Box 2659, Cleveland 7, Ohio.** 272B

Package Pump

High efficiency pumping for small wells.

Marketed as a complete pumping package the Verti-Line Package Pump promises 80% efficiencies for wells as small as 4 in. in diameter. Delivering more water per horsepower means top economic operation for the user. Tailored specifically for the small well the unit's largest application would be to 6 in. dia. wells.

Offered in sizes from 2 through 7½ hp. the pump will produce heads up to 340 ft. at capacities from 200 to 7,500 gph. The package contains all the necessary equipment including accessories such as a foot valve and strainer, column and shaft assembly. — **Layne & Bowler Pump Co., 2943 Vail Ave., Los Angeles 22, Calif.** 272C



Exhauster

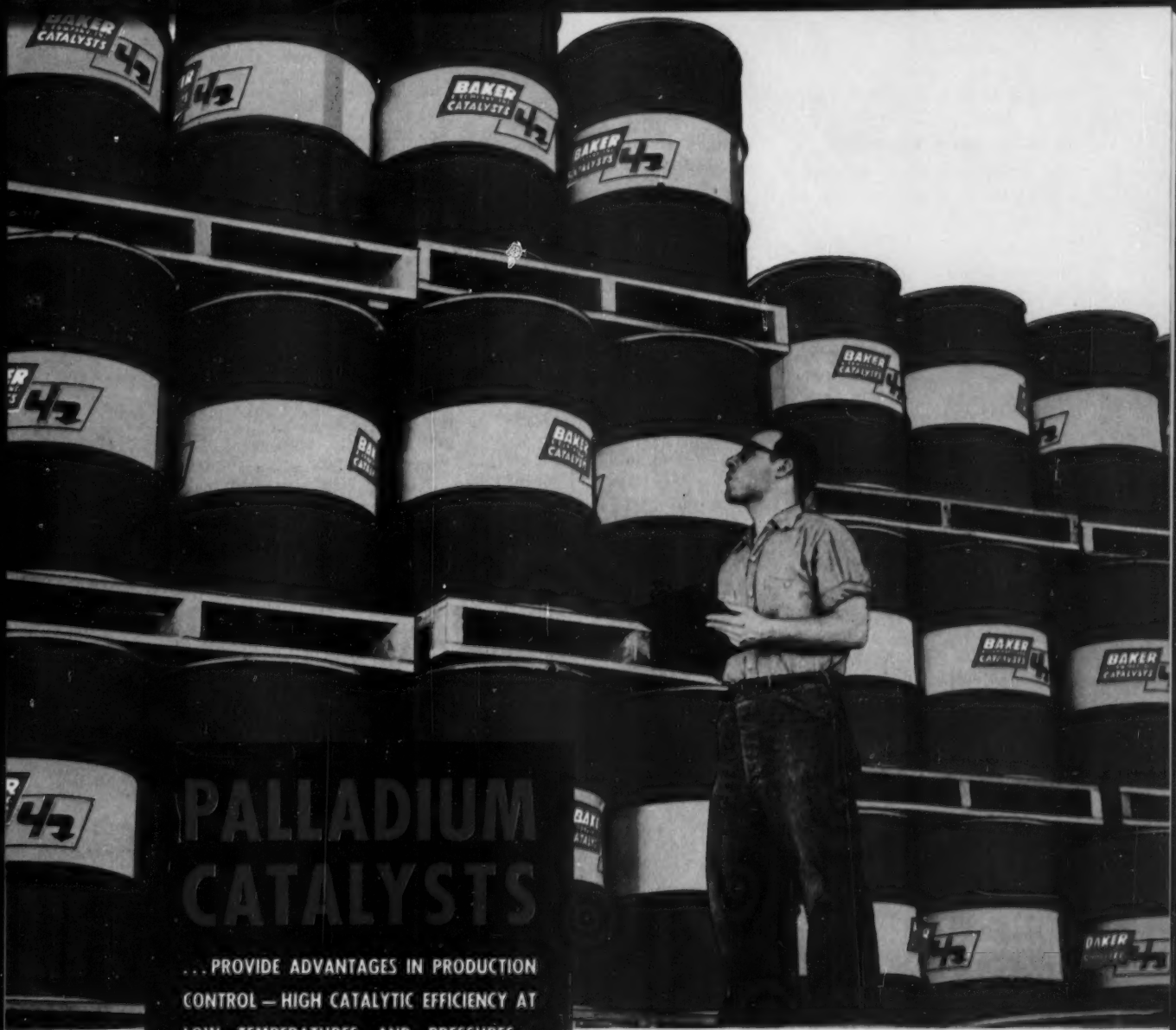
Vents gases and fumes without exposing fan or motor.

Developed for industrial venting and commercial heating plants, a new power exhauster runs without exposing fan blades or motor to the exhaust gases.

Mounted outside the exhaust unit, the fan and motor run in clean room air or in ducts that supply clean outside air. Unit directs injected air into a conical jet that pulls out the exhaust gas and forces it into the atmosphere.

Because neither fan nor motor are exposed, maintenance cost is reduced materially. Downtime is eliminated. In the event of power failure, vent lines are unobstructed by idle fans and motors.

Exhausters are built for vent diameters of 12, 14, 16, 18, 20, 22, 24 and 30 in.—**Quickdraft Co., Dueber-Hampden Bldg., P. O. Box 87, Canton 1, Ohio.** 272D



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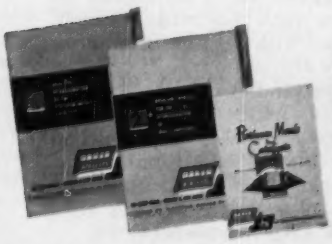

Literature on Platinum Metals Catalysts is available and will be sent at once, upon request.

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Hot Rubber Blanket

Wraps around irregular surfaces to provide heat up to 220 F.

Quick, even heat is delivered to hard-to-get-at places by Us-Kon rubber electrical blankets. Using a conductive rubber element instead of heating wires, blanket can be bent around corners, stuck into crevices, wrapped around objects or applied between surfaces and put under pressure. It can be glued to almost any surface and nailed or stapled along the edges.

Blanket has sandwich-like construction. In the center is a paper-thin layer of rubber which conducts electricity instead of insulating against it like rubber normally does. This is vulcanized between two sheets of non-conductive neoprene rubber. The conductive rubber is energized by a flat conductor which runs along only two parallel edges of the blanket under the neoprene cover.

Blanket comes in a wide range of sizes with choice of wear resistant, waterproof and chemically resistant constructions.—**United States Rubber, 1230 Avenue of the Americas, New York 20, N. Y.** 274A

Heat Exchanger

Has extended surface that beats transfer rate of finned type.

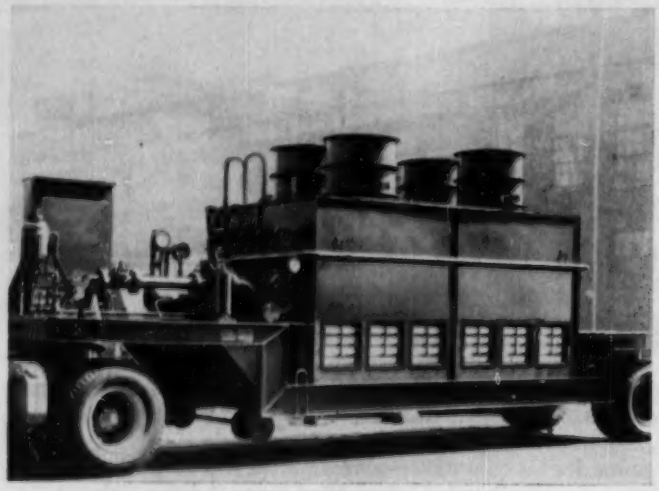
Heat transfer rates 1½ to 5 times greater than conventional finned surfaces of equivalent diameter are claimed for the Thermek tubular heat exchanger. It is recommended for oil heating, oil cooling, water or steam heating, water cooling, vapor condensing, cooling of compressed air, cooling by gas expansion in an industrial refrigerant system.

Basically, Thermek is an outer shell and an inner tube with a heat transfer surface between them. The inner tube has been machined around and along its outer surface to produce a closely packed array of spines. These spines provide an integral extended surface for heat exchange.

Thermek heat exchangers can be obtained in outer shell diameters ranging from ¾ to 2⅛ in. O. D. with inner shell diameters from ½ to 1⅛ in. I. D. There is a wide choice of metals.—**Heatron, Inc., 333 Eberts Lane, York, Pa.** 274C

For More Information...

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.



Portable Cooling Tower Rolls Into Action

This unique water-cooling tower on wheels is completely equipped with pumps, strainers, electrical control equipment, pressure gages, thermometers and feed water conditioner. Unit cools 240 gpm. of 115 F. water down to 90 F. using 95 F. air with an 80 F. wet bulb temperature. Right now, it's used with portable oxygen generators in remote locations, can solve shortage of cooling water for small chemical plants, diesel power stations and air conditioned industrial or commercial buildings.—Badger Mfg. Co., Cambridge, Mass. 274B

Finned Coil

Can be furnished with extra-heavy pipe, has square fins.

A new type of cooling coil developed for refrigeration is believed to offer advantages for cooling or precooling gases and liquids. A perfect bond is claimed between fin and pipe. While most coils of this type can only be furnished in full-weight pipe, this square-finned coil can be built with extra-heavy pipe.

Fins are made of 14-gage steel, split into leaves or tabs at the center. After the fins have been placed in position, the forked leaves are forced together until they make intimate contact with the pipe around its entire circumference.

Fins and pipe are further bonded with hot liquid galvanizing spelter. The finished structure is so strong that a man can stand on the fin in any position without loosening it.—**Frick Co., Waynesboro, Pa.** 274D

—Photograph courtesy of Standard Oil Co. of N. J.

with Ljungstrom® Air Preheaters, four of your present stills can do the work of five

You'll have far less slag—much less downtime for maintenance—with the Ljungstrom Air Preheater. This unit produces more complete combustion, at higher temperatures, because preheated air mixes more thoroughly with fuel. And in addition, Ljungstrom efficiency makes possible finer process control and advanced furnace designs. Thus, Ljungstrom savings are real and measurable. One still, Ljungstrom equipped, added $58,000 of income annually from higher product quality alone.

How fast is "WRITE OFF"?

Unusually short. Major savings are gained from higher average octane ratings. And other Ljungstrom advantages —up to 20% fuel savings . . . more economical furnace design, with no need for convection surfaces . . . use of many fuels you used to throw away . . . consistently higher throughput . . . shorter turnaround time—mean that a Ljungstrom is paid out in a very few months.

For more complete details on what the Ljungstrom Air Preheater can do for you . . . for an analysis of the heat recovery benefits attainable in fuel burning equipment—call or write the Air Preheater Corporation.

Wherever You Burn Fuel, You Need Ljungstrom

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

Swenson Puts Ideas

For the Processing Industry!

Ideas for better process methods will start to work for you when you read Swenson's new 12-page brochure, "An Open Door". Just off the press it shows how Swenson Engineering assists in solving many evaporation, crystallization, filtration, pulp washing and spray drying problems.

It introduces the facilities and operations of the Swenson Evaporator Company. Many installations of Swenson equipment are illustrated and described. Truly "An Open Door" to lower production costs, it shows how experience combined with extensive research and modern manufacturing provides the equipment best suited to particular needs. Whatever your position . . . engineer, president, manager, chemist . . . be sure to request this brochure. It is interesting and informative. Send for your copy today!

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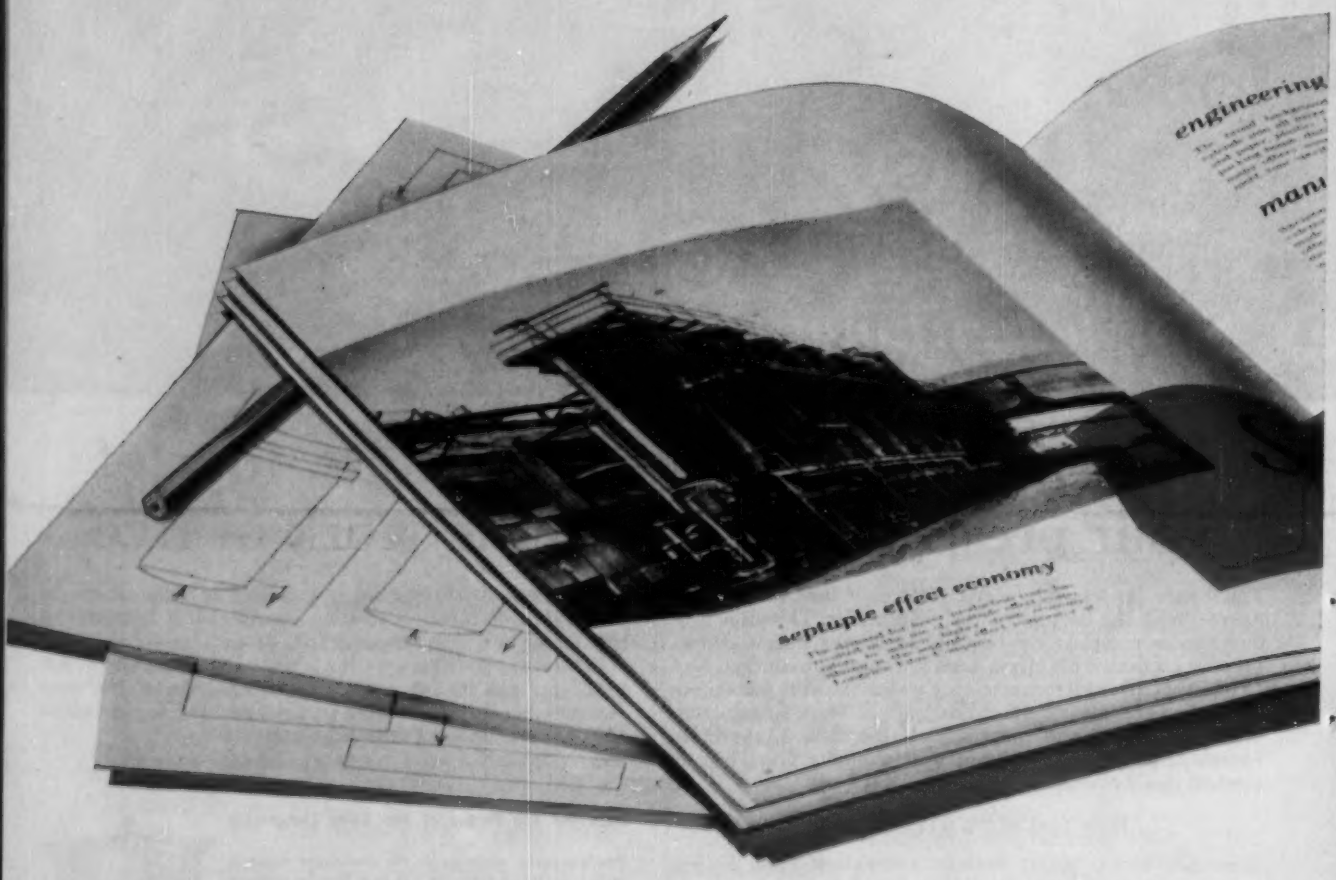
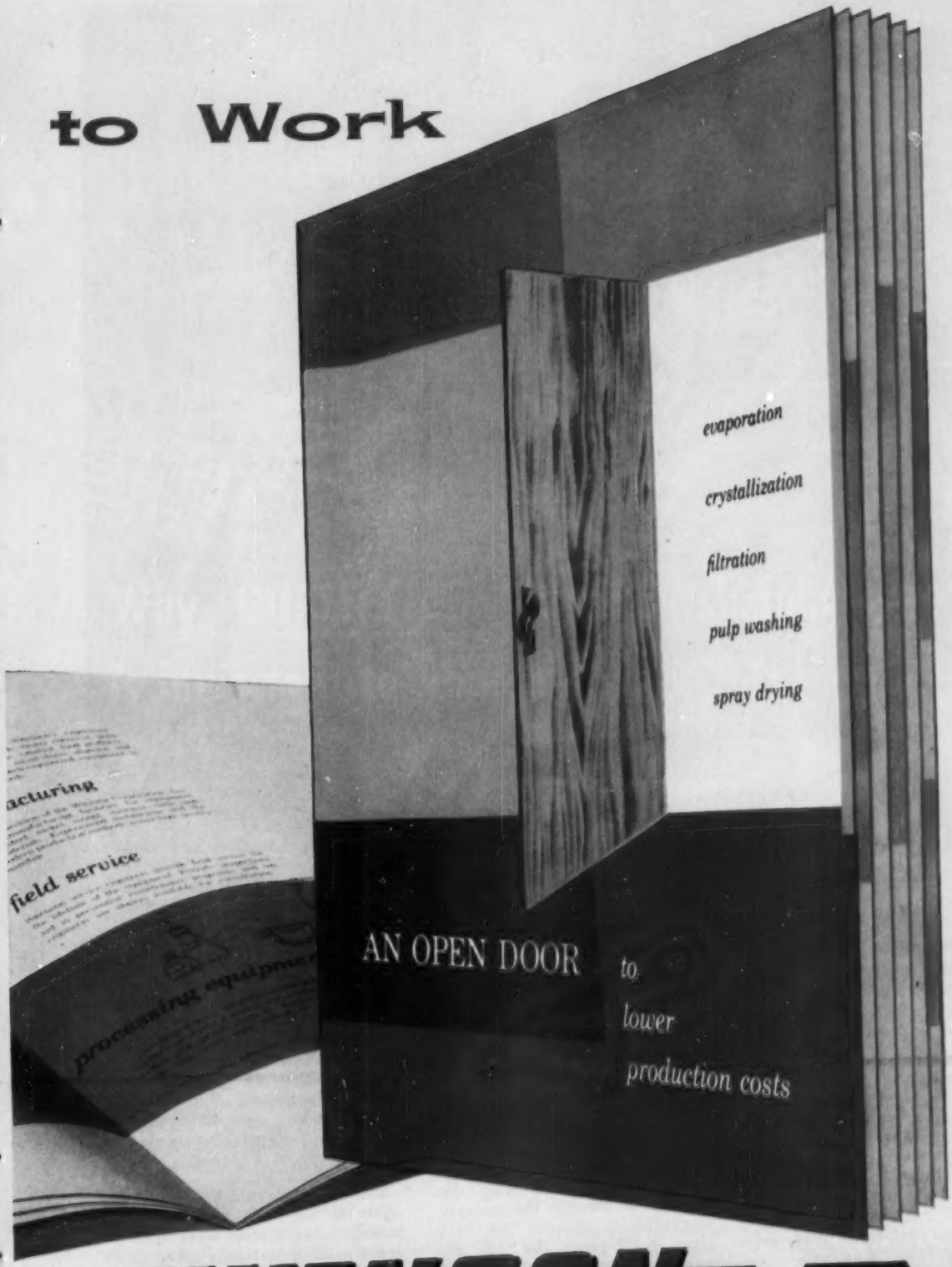


to Work



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U.S. Sulfur Balance

(Thousand long tons, sulfur equiv.)	1953		1954		1955	
Sources						
Sulfur mined (Frasch)	5,155		5,516		5,743	
Producers' year-end stocks	3,022		3,228		3,181	
Change in producers' stocks	−47		+206		−47	
Apparent Frasch sulfur sales		5,202		5,310		5,790
Sulfur from H_2S	337		357		402	
Producers' year-end stocks	107		109		111	
Change in producers' stocks	+12		+2		+2	
Apparent H_2S sulfur sales		324		355		400
Imports	.....		.....		31	
Low-grade ore	10		35		40	
Domestic pyrites	372		395		425	
Imported pyrites	90		125		140	
Smelter gases	267		275		345	
Sour gases and sludge to acid	165		230		270	
Withdrawn from users' stocks	.....		79		.....	
Total sulfur in alternates		904		1,139		1,251
Total equivalent sulfur supply		6,430		6,804		7,441
Disposition						
Wood pulping[1]	390		400		425	
Carbon bisulfide	220		215		300	
Other chemicals, dyes	95		90		125	
Insecticides, fungicides	100		100		125	
Rubber	80		75		80	
Other non-acid uses	135		135		195	
Sulfuric acid						
As sulfur	3,120		3,264		3,566	
As alternates	894		890		997	
Exports	1,242		1,635		1,598	
Users' stocks	154		.....		30	
Total sulfur used		6,430		6,804		7,441

[1] Includes pyrites sulfur (10,000 long tons est.) going to sulfite liquor.

Sulfur, H_2SO_4 Stack Records

Sulfur output rocketed, yet huge demand forced importation. U. S. producers look to off-shore and surface sulfur to help close the gap.

T. Peter Forbath, Assistant Editor

If, by some unlikely chance, you didn't know American business was booming in 1955 a look at sulfur and sulfuric acid doings would set you straight fast. For last year these traditional industrial barometers shattered all previous production and consumption highs—even those registered in record-breaking 1954. And this year they'll no doubt go still higher.

Every sulfur source chipped in with expanded production. Frasch sulfur swelled coffers with a record 5.7 million long tons—4% better than 1954. Sulfur recovered from sour gas soared 12% to 402,000 long tons. Equivalent sulfur production from pyrites stepped up 8%, from smelter gas, 25%.

▶**Outside Sulfur Needed**—Yet domestic expansion was not enough to satisfy the hungry marketplace. So for the first time in 50 years the U.S. imported a significant quantity of native sulfur, 31,000 long tons. It was Frasch sulfur and came from Mexico's pioneering brimstone frontier in Vera Cruz.

Pyrites imports from Canada were kicked up 15%. Still, sales exceeded production and suppliers ate into their stocks to meet demands. Total equivalent sulfur supply hit 7.5 million long tons—a 10% increase over 1954.

▶**New Domes for Frasch**—Of '55's 250,000-long ton gain in Frasch sulfur, the biggest portion came from increased output of Texas Gulf's Boling Dome in Texas. Freeport Sulphur brought in Chacahoula Dome in Louisiana. But its addition to the over-all Frasch pool was substantially canceled by the loss of Freeport's veteran Hoskins Mound.

Hoskins, the oldest Frasch mine in the world, finally exhausted itself and was shutdown in May last year after 32 years of operation. Over that span 11 million long tons of brimstone were pumped from its prodigious belly. So, with one dome out and a new one in, the number of U.S. mines remained at 13, delivering 67% of

QUALITY control measures that end at your plant door aren't enough. Your product can become seriously contaminated if shipped in containers that aren't specially treated to maintain your product's purity.

Contaminated products are great "customer-losers." Yet, contamination-en-route can be avoided by shipping in USS Steel Drums. That's because every USS Steel Drum goes through several special steps to make all surfaces spotlessly clean and free of scale. Once inner and outer surfaces are prepared, they are thoroughly coated with a special phosphate solution that assures long-term freedom from rust. This combination of immaculate steel surfaces and special phosphate-coating protection means that your product will arrive at your customer's door as pure as the moment it left your plant —when you ship in USS Steel Drums.

Product-protecting USS Steel Drums are available in sizes from 2½ to 110 gallons, either plain or decorated. To meet special needs, we have a wide variety of custom fittings and openings.

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UNITED STATES STEEL

U.S. Sulfuric Acid Balance

(Thousand short tons, 100% acid)	1953		1954		1955	
Sources						
Sulfur	10,127		10,310		11,300	
Pyrites	1,500		1,330		1,702	
Smelter gases	868		886		1,112	
Sour gases	207		265		170	
Refinery sludge[1]	325		480		700	
Total new acid		13,027		13,271		14,984
Spent acid refortified[2]	976		725		774	
Acid reused as such	1,297		1,104		1,250	
Total recycled acid		2,273		1,829		2,024
Total acid available		15,300		15,100		17,008
Disposition (gross before recovery)						
Fertilizer materials						
Superphosphate and mixing	4,050		4,060		4,650	
Ammonium sulfate	1,150		1,320		1,650	
Chemicals	4,000		3,880		4,195	
Petroleum refining	1,780		1,770		1,800	
Inorganic pigments	1,300		1,300		1,400	
Rayon and film	670		620		750	
Iron and steel	1,010		850		1,160	
Other metallurgical	220		220		248	
Industrial explosives	420		400		450	
Textile finishing	30		30		30	
Miscellaneous[3]	670		650		675	
Total acid used		15,300		15,100		17,008

[1] Sludge burned in sludge-conversion plants is reported as new acid, replacing an approximately equivalent amount of new sulfur.
[2] Spent acid as drip acid in contact plants. Reported in "gross acid" by Bureau of Census.
[3] Includes estimated gross acid to military explosives.

all sulphur consumed this year.

Activity quickened in exploration and development of off-shore sulfur. Freeport advanced work on its Lake Pelto deposit off the Louisiana coast. Sunk six to eight feet below the blue surface of the Gulf of Mexico, the dome poses rough mining problems but promises a rewarding strike.

Humble Oil Co. estimates that, at its Block 18 site, the Gulf floor holds a sulfur cache of 30-40 million long tons.

And others are out fishing for sulfur in the Gulf. Texas Gulf and Shell Oil paid out $7.1 million and $1.2 million, respectively, for off-shore leases in the hope of hooking their own drowned deposits.

▶**Mexican Sulfur Comes of Age**—Two producers on the Isthmus of Tehuantepec made 1955 the first full year of Mexican Frasch sulfur production. Pan American Sulphur brought some 400,000 long tons to the surface; Mexican Gulf Sulphur, about 100,000 tons. Other outfits herald imminent production. Among them: Texas Gulf and Gulf Sulphur.

And prospectors continue to roam the area in search of the yellow mineral. Latest to shoulder pick and shovel: Texas International Sulphur. With rights to 126,000 acres, TIS announced that 300 of them alone hold 5 million tons of brimstone.

All in all, about 80 million long tons of brimstone are believed to be buried in the one million acre Isthmus site set aside by the Mexican government as a sulfur reserve.

Thus Mexico rates as the U.S.'s stiffest potential brimstone competitor for world markets. She'll have a lot of sulfur to sell—600,000 long tons are expected to come from Mexican mines this year and over one million long tons in 1957. And her export price is attractive—$25/long ton. (It's interesting to note that this spring Freeport Sulphur shaved its export price $3/long ton to $28/long ton, the price which domestic users pay for sulfur. Texas Gulf followed suit recently.)*

*Freeport Sulphur is reported to be forming a Mexican subsidiary to explore and develop sulfur deposits in the Isthmus of Tehuantepec.

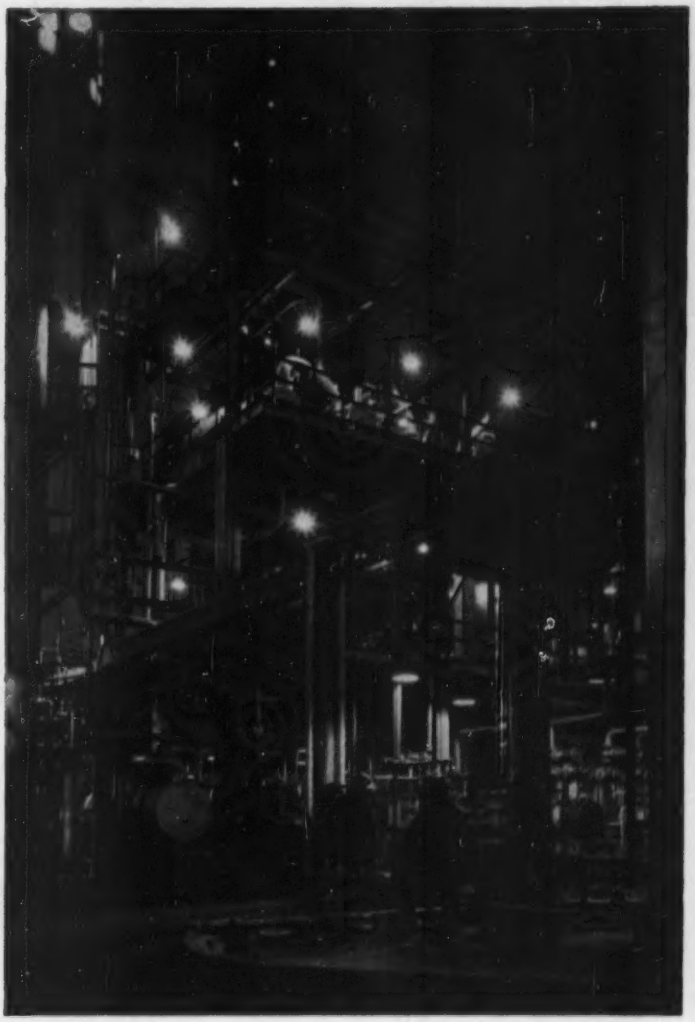
▶**Big Boost from Non-Frasch**—Three new hydrogen sulfide-sulfur recovery plants went on stream last year to boost the total number in the U.S. to 43. Jefferson Lake Sulphur accounted for one at Manderson, Wyo.; J. L. Parker Co. for one at Penwell, Tex., and, together with Signal Oil and Gas Co., for one at 4-Mile Field, Wyo.

Rico Argentine Mining Co's new plant at Rico, Colo. can be credited for the increase in equivalent sulfur production from domestic pyrites.

Increased output from the Leviathan, Calif. low-grade ore surface mine allowed Anaconda to up its ore-based contact acid plant operation at Yerrington, Nev. Other outfits got into the surface-sulfur picture in 1955. American Sulphur and Refining Co. began construction of a facility to handle low-grade ore from a nearby surface mine at Sulphurdale, Utah. Texas-Adams Oil bought U.S. Sulphur's 31 acres of 30% sulfur surface deposit, rated at 500,000 long tons.

▶**Sulfur Went This Way**—Last year saw no change in the do-

ON-STREAM...DAY AND NIGHT



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The Udex extraction unit of Sinclair Refining Company at its refinery at Marcus Hook, Pa., operates on-stream 24 hours a day. Toluol, Xylol and Paraxylene produced from this Udex unit meet important industrial needs for high purity petrochemicals in quantity.

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mestic end use pattern of sulfur. As usual sulfuric acid nabbed the lion's share—62%. Non-acid users allocated a total of 16%, and 22% sailed to foreign ports.

With most acid users enjoying a big year, sulfuric acid production reached 17.0 million short tons (as 100% acid), a 11% increase over 1953, the best previous year.

Non-acid consumption of sulfur increased but not as much as expected. The wood pulp industry's shift from sulfur-consuming sulfite process to the salt-cake-consuming sulfate process forced the under-par showing.

Top consumer of sulfuric acid was the fertilizer industry, but its increased demand fell below what might have been expected with over-all acid consumption swinging along at a faster clip. Uncertainty as to the impact of farm legislation can take blame for much of this disappointing showing. Fertilizer manufacturers tapered off their production to watch the first and second farm bill's legislative journeys and to gauge their effect on the farmer's inclination to invest in fertilizer.

Sulfuric acid consumption by the rayon industry was heavy as output of rayon staple and yarn climbed 28% over its '54 level. Record-breaking steel activity during the year called for large volumes of acid for pickling.

▶**More Acid Works Second Shift**—Sulfuric acid that performs double duty, as reused, reconstituted or refortified acid, gained greater popularity during 1955. Vigorous antipollution campaigns did much to encourage this trend. Salvaging refinery sludge acid increased markedly. Above 7% of total acid used was garnered in this manner.

Of the total acid available, 83% was new acid (including reconstituted sludge), 8% reused and 9% spent acid refortified in contact sulfuric acid plants. Over 75% of the new acid was made from Frasch sulfur, 7% from pyrites, 8% from H_2S, 5% from smelter gas and 5% from reconstituted refinery sludge.

Chemical Consumption

Consumption by Industries

	March (Final)	April (Est.)
Coal products	12.7	12.5
Explosives	10.1	10.9
Fertilizer	82.3	81.6
Glass	26.3	26.4
Iron & steel	20.0	19.3
Leather	4.2	4.2
Paint & varnish	31.6	32.8
Petroleum refining	31.9	29.3
Plastics	30.6	30.1
Pulp & paper	39.1	37.8
Rayon	31.5	28.4
Rubber	7.3	6.9
Textiles	11.5	10.6
Total	340	331

Chart Your Manpower Needs Six Months Ahead

You can do just that, and with 97% accuracy, too, according to Leland Srigley, originator of a formula which looks like this:

$$E = \frac{H_r K}{H_m P_e}$$

where E is the number of employees required each month; H_r is the standard hour demand of planned and unplanned items for each given month; K is a factor; H_m is the number of hours per operator available each month; and P_e is a three-month average performance for a particular division.

Srigley claims his formula—which is being tested by Parke, Davis & Co. right now—practically eliminates guesswork in the amount of hiring and appreciably trims layoffs. This means better employee morale, and savings for the employer in the form of reduced unemployment benefits payments.

Chemical Inventories Are Higher but Healthy

At the first quarter mark of 1956, chemical inventories were 57% higher in terms of current dollars, than during the 1947-49 base period. In March of this year they reached a peak of $3,357 million which was 5% above the 1955 year-end stock position. So reports the Commerce Dept.'s Business and Defense Services Administration in its publication, *Chemical and Rubber Industry Report.*

However, this is not necessarily a disturbingly high level. According to BDSA, all manufacturing industries combined hold inventories 59% above the base period. And, in terms of *constant* dollars, chemical inventories are only 47% over 1947-49 levels.

Furthermore, the all-important stock-to-sales ratio is quite reasonable, largely because chemical producers' sales have soared 67% over the period 1947-49. Last March the ratio for chemicals stood at 1.75 to 1. This is identical with that for the all-manufacturing group and below the year-end stock-sales ratio for 1947-49 and for 1951, 1952 and 1953.

Encouraging, too, are most factors behind the general upswing in chemical inventory dollar values:

- Continuing efforts to diversify product lines—new product output requires supporting inventories for proper distributive flow.
- Tremendous surge in capital expenditures over the past few years.
- Decentralized shipping from warehouses closer to consuming centers.
- Rise in wholesale prices.
- Record chemical sales which require adequate stocks to service distribution channels without interruption.

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...when J-M Goetze gasket specialists make them for you

When you need gaskets such as those above, which were made for pressure vessel service over 5000 psi, consider this. It takes less time and trouble to turn the job over to J-M Goetze —an organization that has specialized in gasket design and manufacture for 67 years. And it usually costs less in the long run.

Goetze engineers can select the right style for maximum sealing efficiency. They know the correct metals and other factors required for efficient, long-lasting gaskets.

Goetze Gaskets are made exactly to the last detail of your specifications and conditions. They are made to craftsmen's perfection . . . with modern machine tools, some of which were specially designed by Goetze for gasket manufacture.

If you need gaskets for high pressure vessels or similar applications, send us a drawing or template for quotation. Or write for further information to Johns-Manville, Box 60, New York 16, New York.

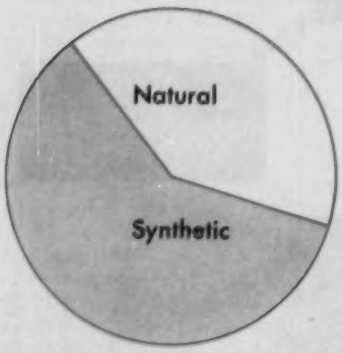
Johns-Manville Goetze GASKETS

THERE'S A JOHNS-MANVILLE PACKING AND GASKET FOR EVERY SERVICE

Synthetic Rubber Goes Abroad

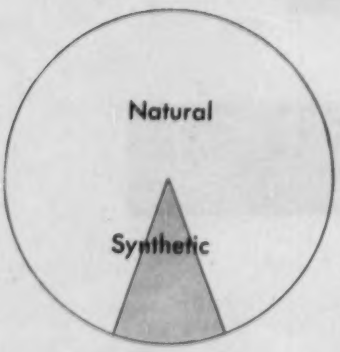
The U. S. synthetic rubber industry, feeling frisky under a new management, private enterprise, looks overseas for new worlds to conquer.

Frances Arne, Assistant Editor



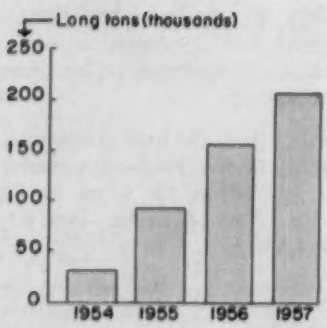
U. S. Consumption

Synthetics hold nearly 60% of domestic market.



Other Consumption

Foreign free world use pattern shows only 11%.



Exports

U. S. rubber makers act to balance things out.

Last year would have been a memorable one for the synthetic rubber industry if only for the fact that for the first time U.S. plants were not only operated, but owned, by private producers.

But 1955's significance goes deeper. It was a year that saw demand goad synthetic rubber production to such a tempo that by 1957 the U.S. will have the capacity to meet *all* our rubber needs should complete substitution prove necessary or desirable.

And U.S. synthetic producers are looking beyond home markets, too. They see big changes coming in the world-wide pattern of rubber distribution. They see an overseas market for their products that makes an even more inviting target than the domestic one, a market that offers an even larger opportunity for future growth.

Let's take a rundown on the forces at work putting the big bounce in the synthetic rubber industry.

• By turning out 970,000 long tons of synthetic rubber last year, more than the industry ever produced in a single year, new non-government owners responded to 1955's record demand. In 1954 only 620,000 long tons were produced. In 1956 production records are still being made and broken. January's record 93,522 long tons has already been beaten by March's 94,339.

• Exports are becoming big business for U.S. synthetic rubber producers, rising from 30,117 long tons in 1954 to 93,289 long tons in 1955. And prophets look for this year's exports of synthetic rubber to top 150,000 long tons. Even so, synthetic rubber in 1955 accounted for only 11% of the new rubber consumed in foreign free world countries. Compare this with synthetic's 59% share of the U.S. market and you see why producers are eyeing the overseas potential.

The see-saw between natural and synthetic rubbers seems finally to have inclined permanently in the direction of synthetics. In each successive quarter of 1955, the percentage of natural rubber to total rubber consumption decreased not only here but in the rest of the world as well. During the first quarter of 1956, world output of natural was down 8.5% from last year's mark for the same period.

• American synthetic rubber makers announced plant expansion plans totaling some $116 million. Firestone, for example, is raising GR-S capacity of its Akron and Lake Charles plants—rated at 30,000 and 99,600 long tons/yr., respectively, when purchased from the government last year—to 189,900 long tons. Goodyear is raising its Akron and Houston plants from a total of 114,800 to 149,400 long tons/yr. Phillips' 63,000-ton Borger, Tex., unit will go to 116,300 long tons/yr.

• Man-made "natural" rubber was developed by four companies. One, Goodrich-Gulf, has started building a plant in Avon Lake, Ohio. Its product, as well as those of Firestone and Goodyear, is primarily cis-1,4-polyisoprene. Phillips Petroleum's synthetic natural rubber is butadiene-based, does not use styrene.

► **Demands Quicken** — Outlook for here on in is for a steady rise in consumption of rubber, more rapid abroad than in the U.S. For a variety of reasons, both economic and political, few foresee more than a very modest rise in natural output in the next five years. Thus, new demands will be met by expanding synthetic capacity here, building plants abroad.

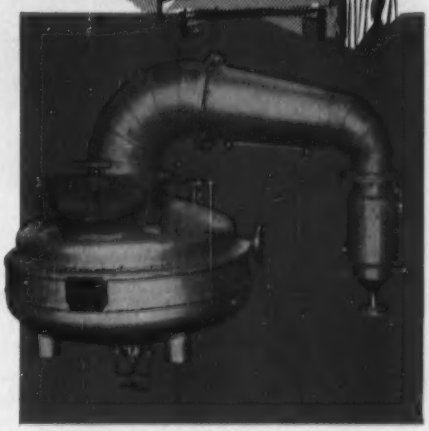
World usage of rubber will tally about 2.8 million long tons this year, with the U.S. accounting for half. Natural output in

was making individualized chemical equipment

The latter half of the 19th Century saw the birth of two important industries: the chemical industry and motion pictures. By the end of the first half of the 20th Century both these industries had matured—one into the full glory of Technicolor and Cinemascope; the other into one of the world's largest manufacturers of chemical products.

Having grown up alongside the American chemical industry for the past 75 years, L. O. KOVEN & BRO., INC. takes pride in having helped chemical manufacturers achieve faster, more efficient output at lower cost. By producing individualized chemical equipment economically and according to the exact specifications of chemical industrialists, KOVEN has itself succeeded in becoming one of this country's foremost contributors to chemical progress.

With experience of this kind under its belt KOVEN feels confident it can help solve your chemical production problems, too. Call or write today for a consultation with a trained representative, and send for Bulletin #550. There's no obligation.



stainless steel jacketed still with downpipe

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KOVEN equipment in all metals and alloys includes: High pressure vessels built to A.S.M.E., A.P.I. Codes; extractors; mixers; stills; kettles; tanks; stacks; breechings; hot transfer lines; light and heavy fabricated piping and plate exhaust ducts. Shop and field erected storage tanks to 2 million gallons. High vacuum testing on liquid oxygen storage tanks.

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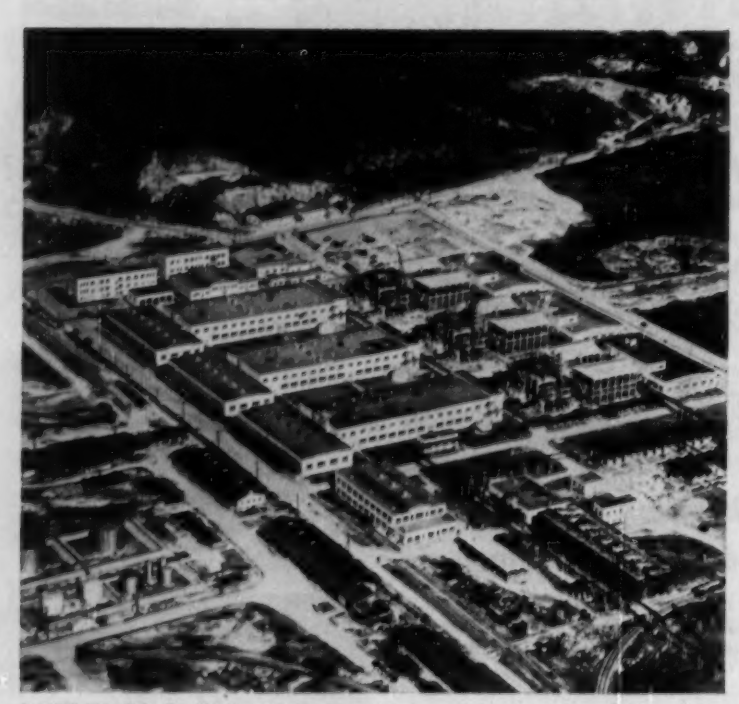


LAST TO GO: Institute plant sale got government out of synthetic rubber.

1956 will run about 1.8 million long tons and output of synthetics about 1.1 million long tons. Nearly all the latter will come from U.S. plants.

Although nearly self-sufficient in a pinch, we will continue to use natural rubber chiefly for technological reasons — probably about the same tonnage, 600,000 long tons/yr., consumed now. The new synthetics that duplicate natural rubber's properties will probably not reach quantity production at competitive prices for five years or more.

▶ **Shortage Abroad?** — Other consuming nations will start feeling a supply pinch. Natural rubber can't meet all their increased needs so they'll have to turn to synthetics.

Right now, it looks as though most of that synthetic will have a U.S. label. For while plants are going up abroad, few foreign countries have sufficient low-cost raw materials to support more than token synthetic production.

The Soviet sphere is an exception. Russia and Poland, particularly, can boost synthetic rubber output greatly. We may see Soviet exports of synthetic rubber, now almost nonexistent, becomes a big factor in trade.

A recent government report makes the following projection of 1960 consumption: U.S. will use 1.673 million long tons, of which 1 million will be synthetic and 670,000 imported natural. Foreign use will total 1.8 million long tons—1.2 million natural and 600,000 synthetic. (This includes Iron Curtain natural rubber usage, excludes synthetic.)

▶ **Feedstocks Follow** — Producers will boost feedstock facilities to keep pace with rubber demands. Companies are planning 110,800 short tons a year more of petroleum butadiene capacity this year and another 168,500 tons in 1957, bringing the total to 940,300 short tons/yr. And increases to 85,550 short tons/yr. are planned in capacity for purification of recycled butadiene.

Production of styrene monomer will be pushed hard during the next half decade, should increase by at least 50% to about 1.5 billion lb./yr.

For rubbers other than GR-S, the government predicts the following capacity increases by 1960: 25,000 long tons for neoprene; 29,800 long tons for N-type rubber.

To Invest Or Not to Invest

Maybe you have a little money to invest. Maybe you'd like to buy some stock—chemical stock.

There are many vital considerations, of course. But the state of technology is the surest indicator of the long-term future of a company—and of an investment.

So here's part of a checklist put together by Richard Windisch of W. E. Burnet & Co. which can help you decide: "Is the company outstanding in its field of technology?"

Company Products:
Are They . . .

Favorably diversified as to number (too few or too many for size), with broad use patterns, with consistent relationship to sales outlets and raw materials?

Free from cut-throat competition, protected by many patents, by advanced know-how, by good trade names, by special sources of raw materials, by low labor factors? Do they lend themselves to long-term contracts?

Widely used by good industries, growing and stable, well situated for foreign trade, secure from foreign dumping, promising for export?

Subject to wide market development and sales increases, by lowering price, by finding new uses as substitutes and to do new things?

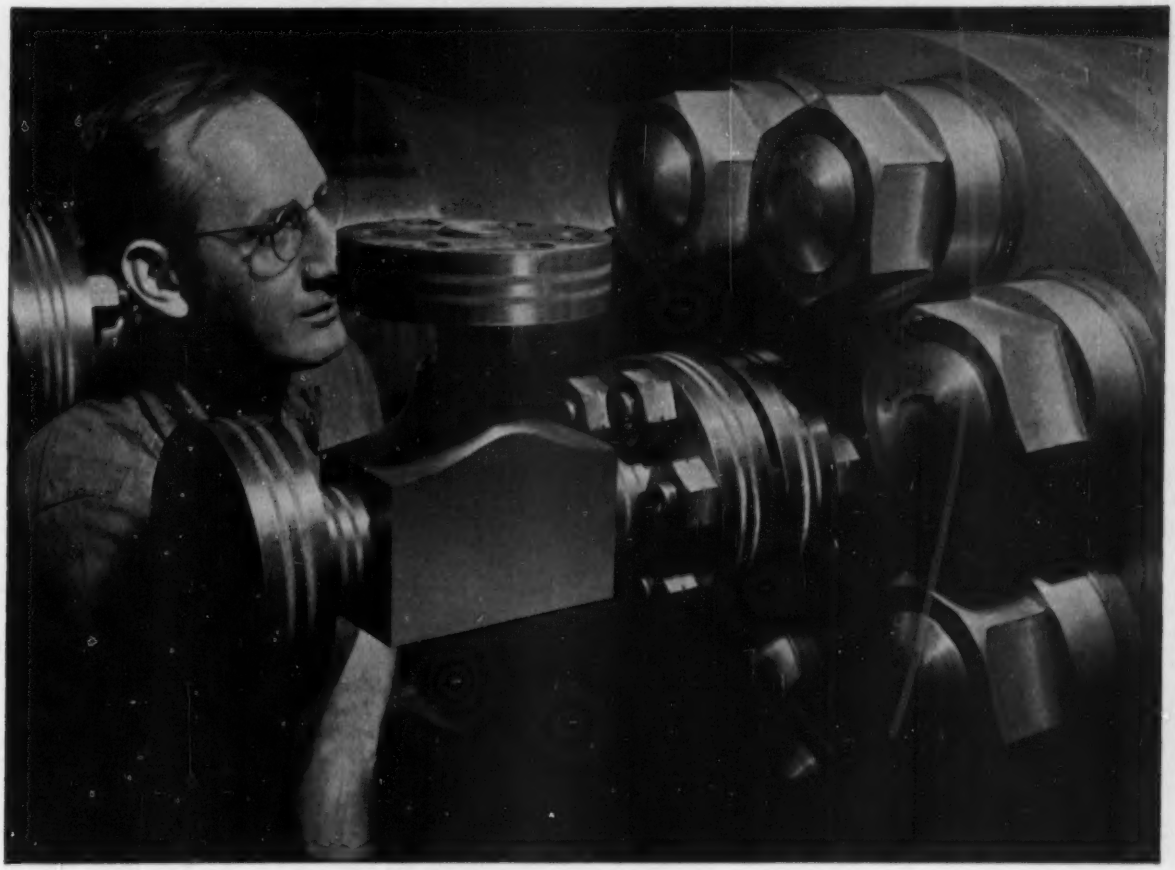
Made from dependable raw materials which are readily available and not controlled by others, are obtained from captive sources, are unlikely to fluctuate in price in normal times?

Free from serious storage or shipping difficulties? Do they require special tank cars, protection against freezing, protection with refrigeration, special containers (non-returnable, sterilized), or special storage facilities?

Free from inventory problem, by not having seasonal demands, by not deteriorating, by not being unwanted coproducts or byproducts, by not being subject to price fluctuations?

Free from substitution and obsolescence, by competing chemicals, by use of other things?

Free from specialized sales problems, like long periods of testing for toxicity and side-effects; professional salesmen; permits from public health commissions, FDA,



No worries here

when the pressure hits the high spots

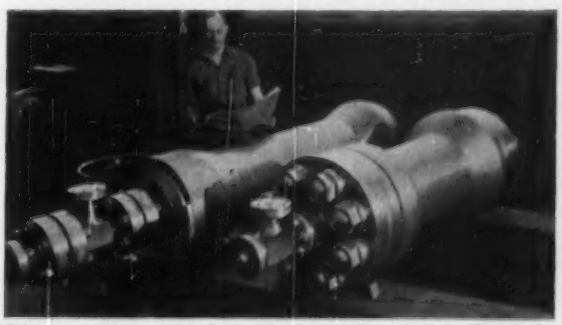
The picture above might make you believe that you're looking at something big and awesome. Actually, it isn't big at all, though it *is* mighty important. It's a forged pressure vessel, a small reactor recently made in the Bethlehem shops. With an ID of only 8 in. and an overall length of less than 10 ft, it weighs something under five tons. But it's designed for high-pressure service; was hydrostatically tested to better than 30,000 psi.

The vessel peeping out of the background is likewise a midget, though the camera seems to have played tricks with it, also. This one is intended for service at even higher pressures. It was tested to more than 50,000 psi.

But you can be sure that Bethlehem builds its full share of giants, too. Some of the biggest forged vessels ever made have been produced in the Bethlehem shops. We are ready for just about anything in pressure vessels, and we do the whole job, from the making of the steel to the finish-machining and assembly.

When you are planning pressure vessels, large or small, our engineers would like to talk it over with you.

Bethlehem is splendidly set up for the manufacture of autoclaves, separators, accumulators, converters, reactors, filters, etc. Call us when we can be of service.



Full view of the two small vessels described at the left. Though for high-pressure service, they have a combined weight of only nine tons.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

ECONOMICS . . .

Dept. of Agriculture, underwriters laboratories?
Integrated, through to end products and from captive raw materials?

Company Plants: Are They . . .

Modern, with maximum automation?
Low in cost, relative to competitors'?
Well located as to markets, raw materials, transportation, labor supply and rates, power and fuel supply?
Flexible and can be used for more than one product?

Company Processes: Are They . . .

Modern, adaptable to automation?
Continuous (low labor factor)?
Unchallenged by competing or rumored new processes?
Free from excessive corrosion requiring high equipment replacement?
Free from expensive pollution problems?
Free from workers' health hazards?
Unique, requiring highly trained workers?

GUIDED TOUR CONTINUED

PICTURED FLOWSHEET

New process yields MgO and HCl 346

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Control and use of foams . . . . . **Oct.**
Design of orifices to limit pipe flow . . . . . **Oct.**
Protective linings for process equipment . . . **Nov.**

$MgCl_2$ Yields MgO, HCl

Fishing in its Carlsbad, N. M. fertilizer plant's waste brine, IMC hooked better than a pirate's sunken treasure chest. Now a new $3.5 million plant takes coveted HCl and MgO from once dumped $MgCl_2$. (p. 346)

Talent on parade

Biographies and backgrounds of your authors add weight and importance to their contributions in this issue. (p. 370)

Technical literature

You can get—free and fast—literature on any subject in your field. Keep files up to date the easy way. (p. 416)

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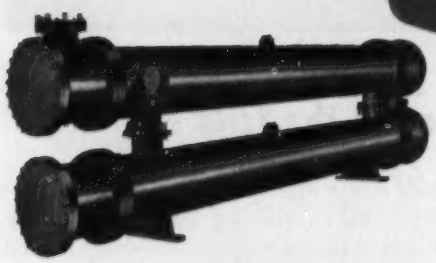
Inside Back Cover

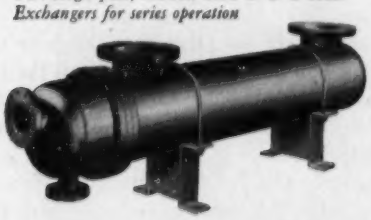
FOR LONG SERVICE
WITHOUT SERVICE

B&G
HEAT EXCHANGERS

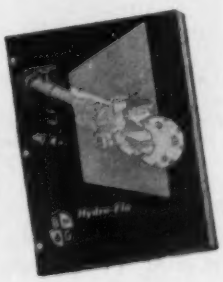
Tank Suction Heaters • Oil Preheaters • Condensers • Evaporators • Aftercoolers • Gas Coolers Oil Coolers • Centrifugal Pumps Water Heaters



Two single pass, channel head B & G Heat Exchangers for series operation



B & G Heat Exchanger with U-bend tubing



For additional information on B & G Heat Exchangers send for Catalog DM-1150.

B & G shell and tube Heat Exchangers give you *more value per dollar because they are built that way!*

Basically efficient in design, these units are offered with straight and U-bend tubing. Ample material thicknesses in every detail and high tensile strength bolting are assurance of lasting strength and long operating life. Full tube bundles and close tolerances between shell wall and baffles prevent slippage of fluid and assure maximum heat transfer. Units can be furnished with tubing of copper, steel, several of the stainless steels and other non-ferrous alloys.

B & G Heat Exchangers are built to ASME Code U-69 requirements and can be certified by Hartford Steam Boiler and Inspection Service.

Whatever your heat exchange problems may be, remember that the B & G engineering staff is always available for consultation.

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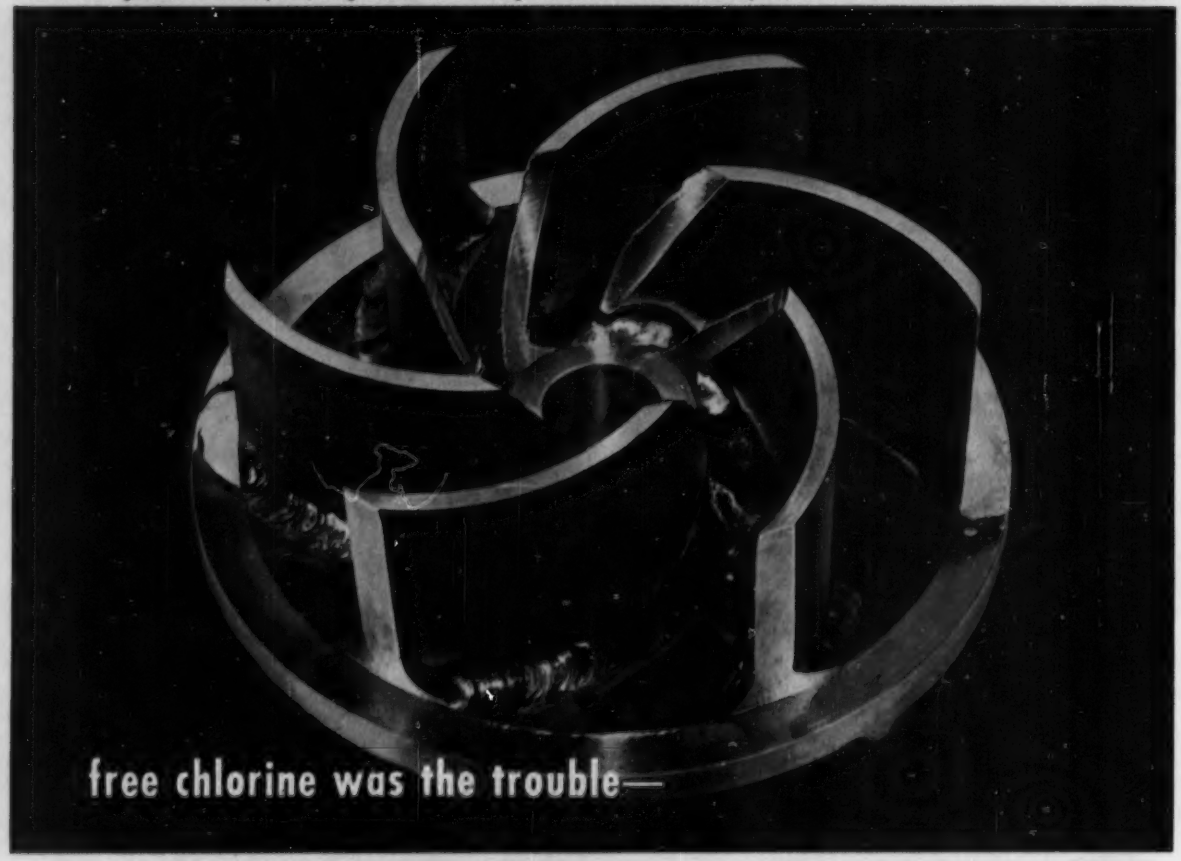
Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada

HOW WAS IT MADE? This impeller is REM-CRU A-55 titanium alloy. Blades were hot-pressed to the desired shape, then welded to the impeller body by Heliarc welding in a helium atmosphere, using A-55 titanium welding wire as filler rod. The assembly was then machined to finished dimensions and balance.



a TITANIUM impeller did the trick

When should you specify titanium? This impeller used by Wyandotte Chemicals Corporation may help show you. It handles a solution of organic chlorides, plus 3½% hydrochloric acid, at 125°F.

The impeller you see here is REM-CRU titanium. Its predecessor was a high-nickel-chromium-molybdenum alloy, which lasted only six months. It was ruined by the attack of free chlorine, which is used in the process.

Titanium not only satisfactorily resists wet chlorine at the temperatures and concentrations involved—it is also extremely resistant to solutions containing the chloride ion at practically all temperatures and concentrations. Furthermore, it is structurally as strong as steel, at 44% less weight.

Therefore, Wyandotte tried this REM-CRU titanium impeller (along with a titanium shaft and key).

After a full year, the impeller was removed and closely inspected. As you can see in the picture, it shows no sign of attack. Wyandotte is convinced that it will last for many years more.

Their experience underlines this fact: the price of a material of construction is unimportant when the part may be expected to give appreciably longer service. This is especially true when the avoidance of down-time costs is considered.

Another point is the help you can get from a REM-CRU engineer. His wide experience with titanium in many applications can be applied directly to your benefit. All you have to do is call him—or, if you prefer, write direct to REM-CRU.

To keep abreast of the latest developments on this vital metal, write to Dept. C-8 for the Rem-Cru Review—a free periodical presenting the latest technical data on titanium alloys.

REM-CRU TITANIUM

REM-CRU TITANIUM, INC., MIDLAND, PENNSYLVANIA

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But the maintenance man measures design by *results*. OIC plug valves get his O. K. because they stay in adjustment a long time without leakage. However, if *you* are interested in the exclusive gland design and construction of these OIC plug valves, write for specification literature.

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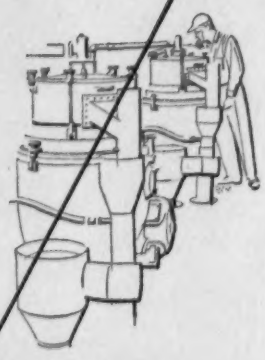
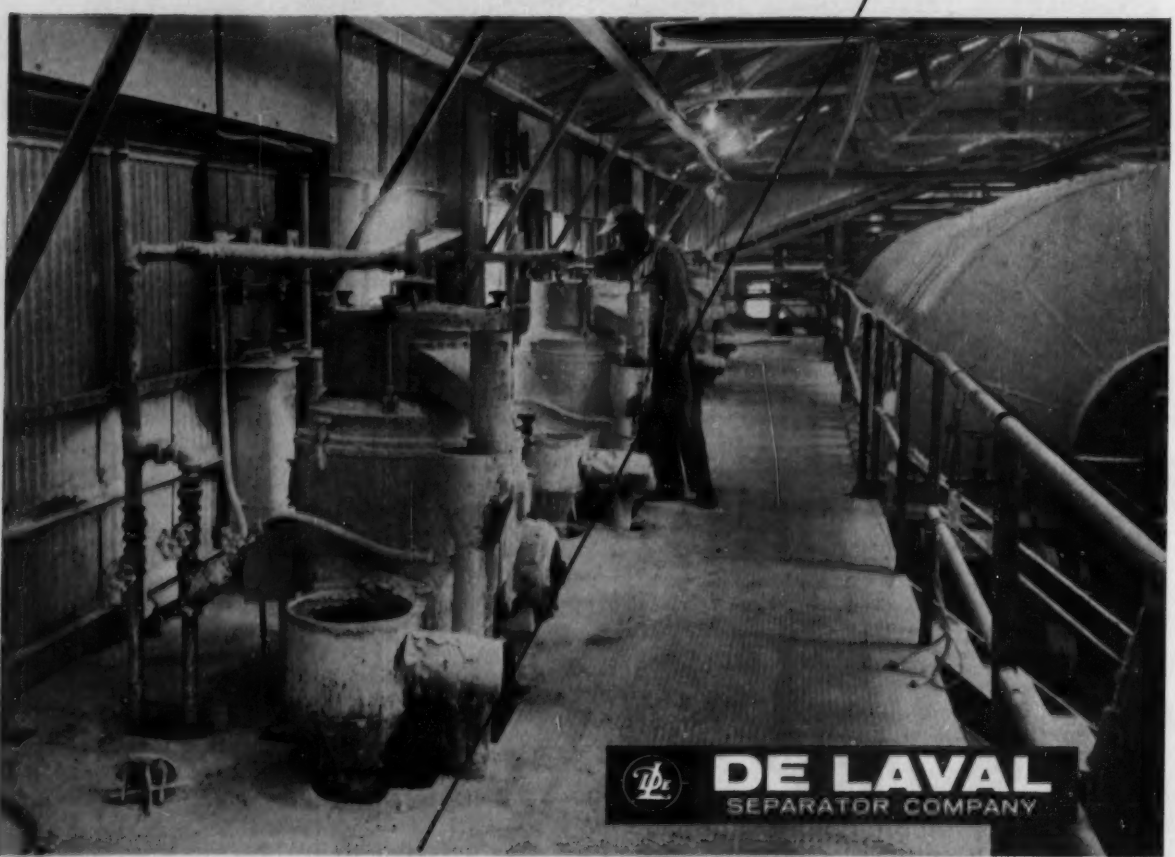
No matter what *you* process... De Laval Centrifugals can save you time and money... and do a better separating job! ***Get all the facts. Write... today!***



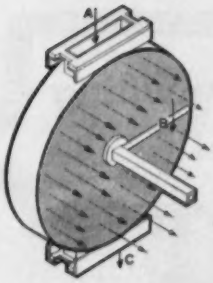


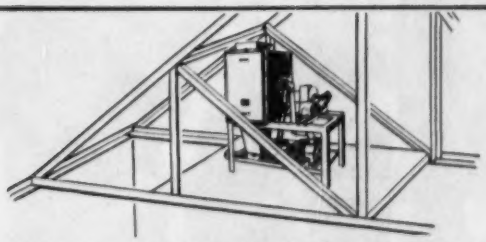
THE DE LAVAL SEPARATOR COMPANY Poughkeepsie, New York • 427 Randolph St., Chicago 6 • DE LAVAL PACIFIC CO. 201 E. Millbrae Ave., Millbrae, Calif.

NEW! KOPPERS model D Aeroturn Dust Collector...

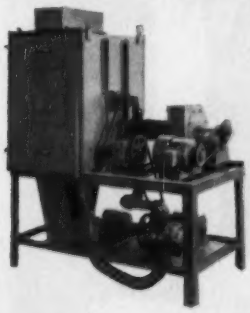
continuously maintains over 99.9% clean air efficiency!

1 Air and dust enter filter drum through top (A). Air passes out through filter disc (shaded) leaving dust on inside. Jet arm (B) rotates around disc blowing reverse-air jet back through filter, dislodging dust. Dust falls out bottom of drum (C) into hopper.

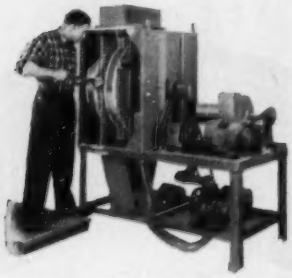




2 All sizes come in "package"—factory assembled—ready to install. Saves space—place unit in rafters, push in corner, mount on platform, out of way. Models from 500 to 4,800 CFM capacities.



3 Automatic pressure control* maintains ideal filter-surface conditions by cleaning filter discs only when they need it and not over-cleaning them. *Continuous* high-efficiency is assured—filters last longer.



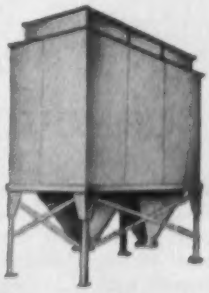
4 High-efficiency felt filtering material cleans more than 6 times as much air per sq. ft. as ordinary woven cloth filters. Synthetic felts for special applications. See how you save time, money, space in your own operation with a Model D Aeroturn.

Compact, yet automatically maintains over 99.9% dust cleaning efficiency. Easy to install—delivered to you *ready to operate!*

The "heart" of this new Koppers Model D Aeroturn (see illus. 1.) is the *reverse-air-jet action.* This reverse air cleans the bag, *maintains* ideal filtering conditions *automatically.*

Pressure controls action by switching air jet arm "on" when pressure rises . . . "off" when pressure is normal for highest efficiency.* When "on" the air jet arm rotates around filter disc radially — blowing an even-pressure air blast into the felt filter disc—agitating and dislodging dust accumulation, making it drop off inner wall into hopper.

No excess wear to "high-efficiency" felt disc—no unnecessary use of air jet mechanism—no stopping to clean. This completely automatic dust collector solves your filtering problems.



New Series 12 Aeroturn for bigger dust filtering jobs, material reclamation. Standard sizes from 1,000 to 60,000 CFM—special units designed for greater capacities. Over 99.9% "clean-air" efficiency.

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...and save us up to 50% in material costs!

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Only with clad steel can you get the protection of solid high alloy—with savings in material costs up to 50%. You get the most economical safeguard against corrosion, abrasion and product contamination. You eliminate high maintenance costs and the risk of unscheduled shutdowns from equipment failure. You have the freedom to change design and equipment layout as your needs change.

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And only Lukens offers a selection of 16 cladding and 11 backing metals—a selection that will meet virtually any conceivable need.

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DESIGN FREEDOM—integral bond allows design and fabrication of shapes to meet process and space needs.

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For surface finish formulation . . .

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with wide variety of evaporation ranges

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. . . for applications where very fast evaporation and high solvency are required.

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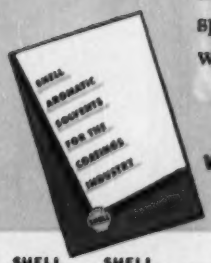

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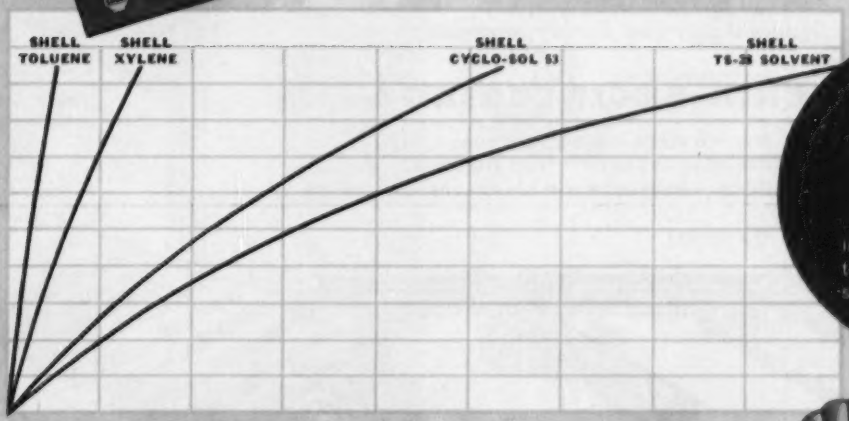

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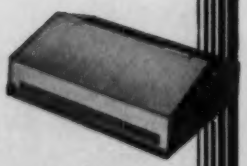
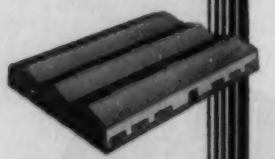


Manufacturing Building for J. I. Case Co., Anniston, Alabama



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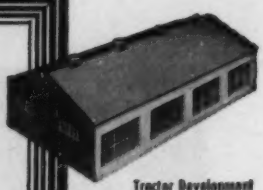

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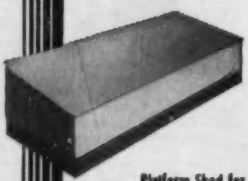

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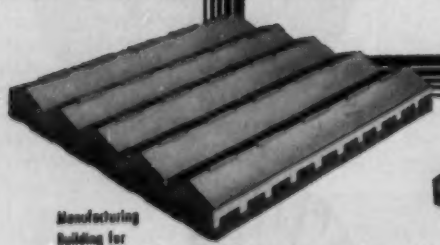

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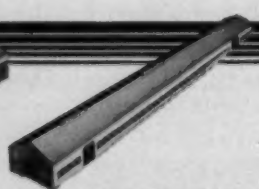
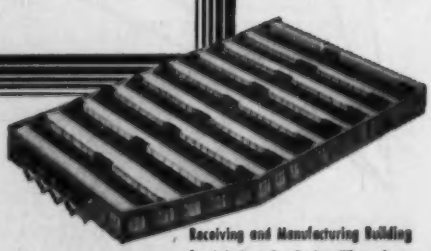


Storage Building for J. I. Case Co., Racine, Wisconsin



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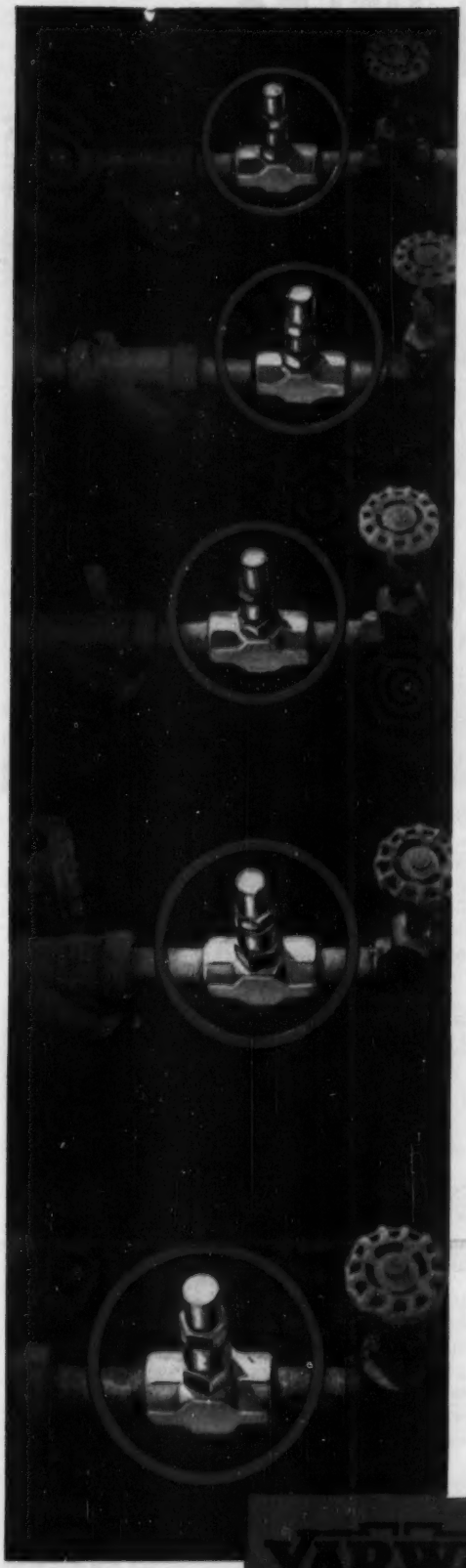

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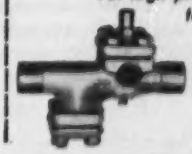

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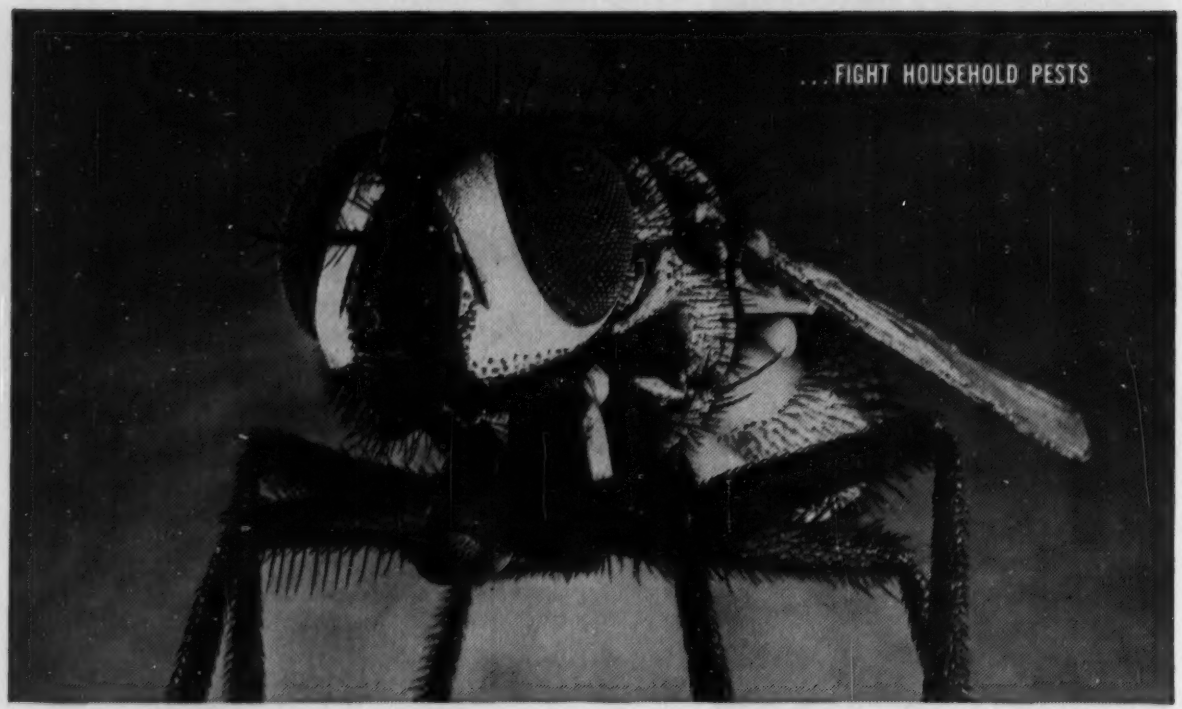

FRIGHTENING CLOSE-UP, this fly can be more than a nuisance. Household insects carry disease, menacing the health of whole communities. To help control flies, mosquitoes, and similar pests, many homeowners rely on insecticides based on Hercules Thanite®. Commercial firms, municipalities, and official insect control agencies have also found that when Thanite is added to their formulations it gives immediate knockdown, plus maximum high kill.

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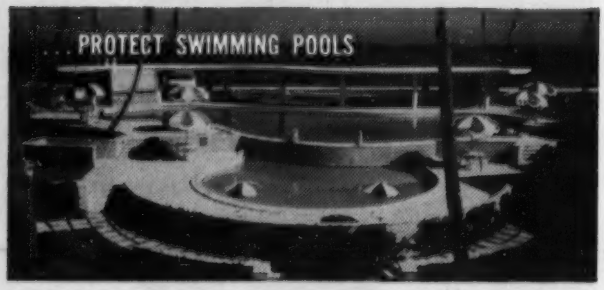

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- Outer cover cannot corrode and bind . . . easily removed.
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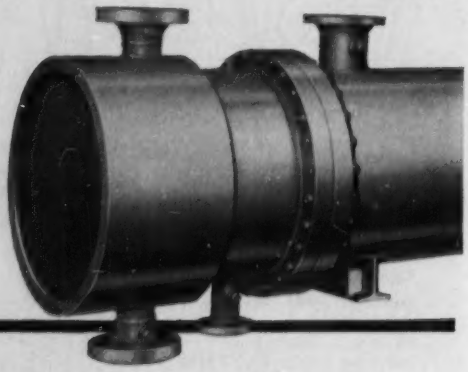
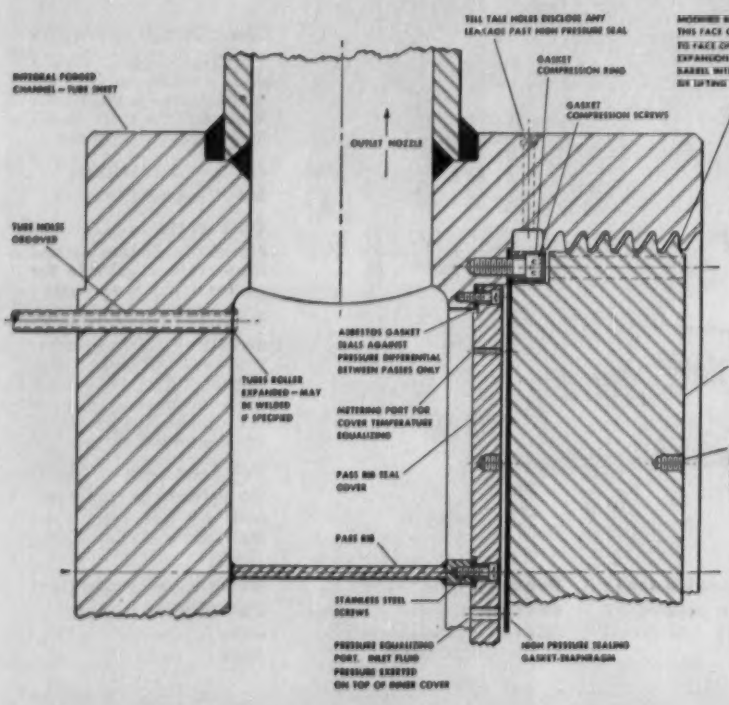
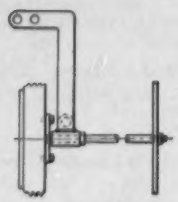
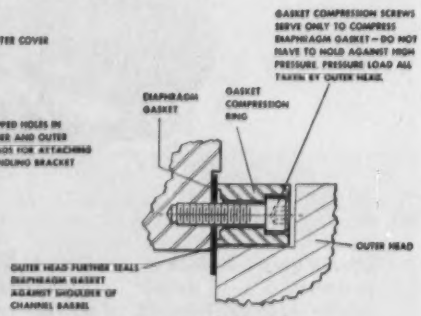


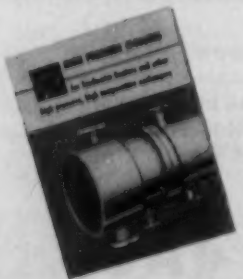

TELL TALE HOLES DISCLOSE ANY LEAKAGE PAST HIGH PRESSURE SEAL
GASKET COMPRESSION RING
GASKET COMPRESSION SCREWS
OUTLET NOZZLE
TUBE HOLES GROOVED
ASBESTOS GASKET SEALS AGAINST PRESSURE DIFFERENTIAL BETWEEN PASSES ONLY
METERING PORT FOR COVER TEMPERATURE EQUALIZING
PASS RIB SEAL COVER
PASS RIB
STAINLESS STEEL SCREWS
OUTER COVER
TAPPED HOLES IN INNER AND OUTER HEADS FOR ATTACHING HANDLING BRACKET



TYPICAL COVER HANDLING BRACKET FOR HORIZONTAL UNIT


GASKET COMPRESSION SCREWS SERVE ONLY TO COMPRESS DIAPHRAGM GASKET – DO NOT HAVE TO HOLD AGAINST HIGH PRESSURE. PRESSURE LOAD ALL TAKEN BY OUTER HEAD.
DIAPHRAGM GASKET
GASKET COMPRESSION RING
OUTER HEAD
OUTER HEAD FURTHER SEALS DIAPHRAGM GASKET AGAINST SHOULDER OF CHANNEL BARREL

DETAIL OF GASKET COMPRESSION RING FACING



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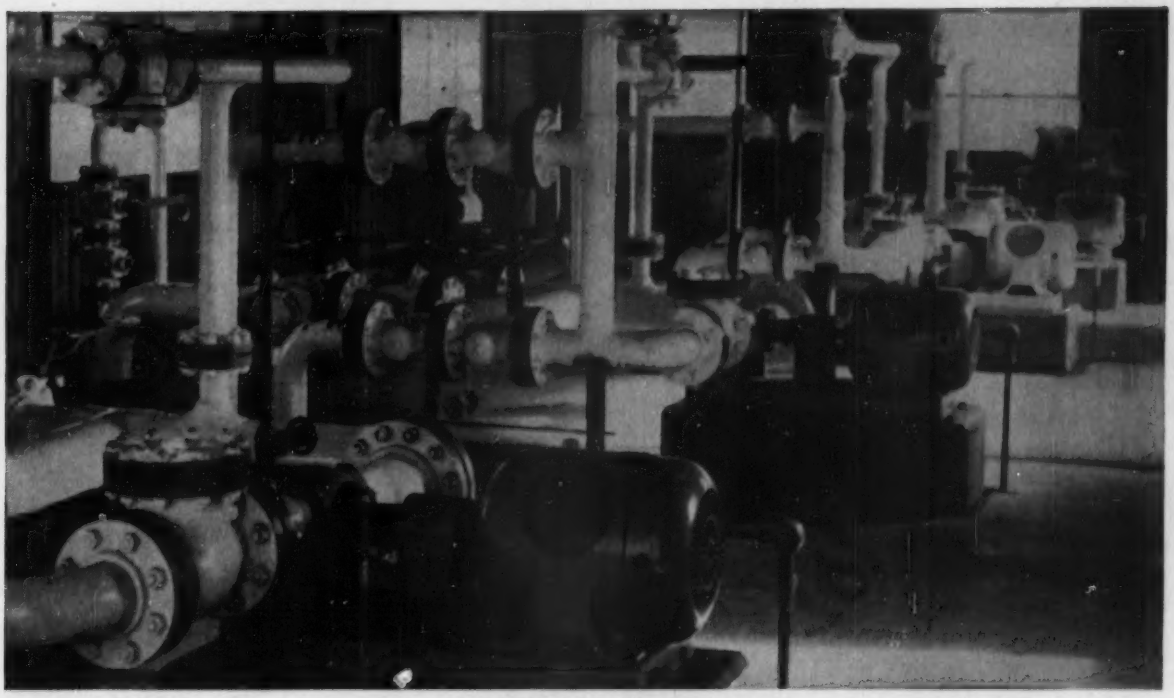

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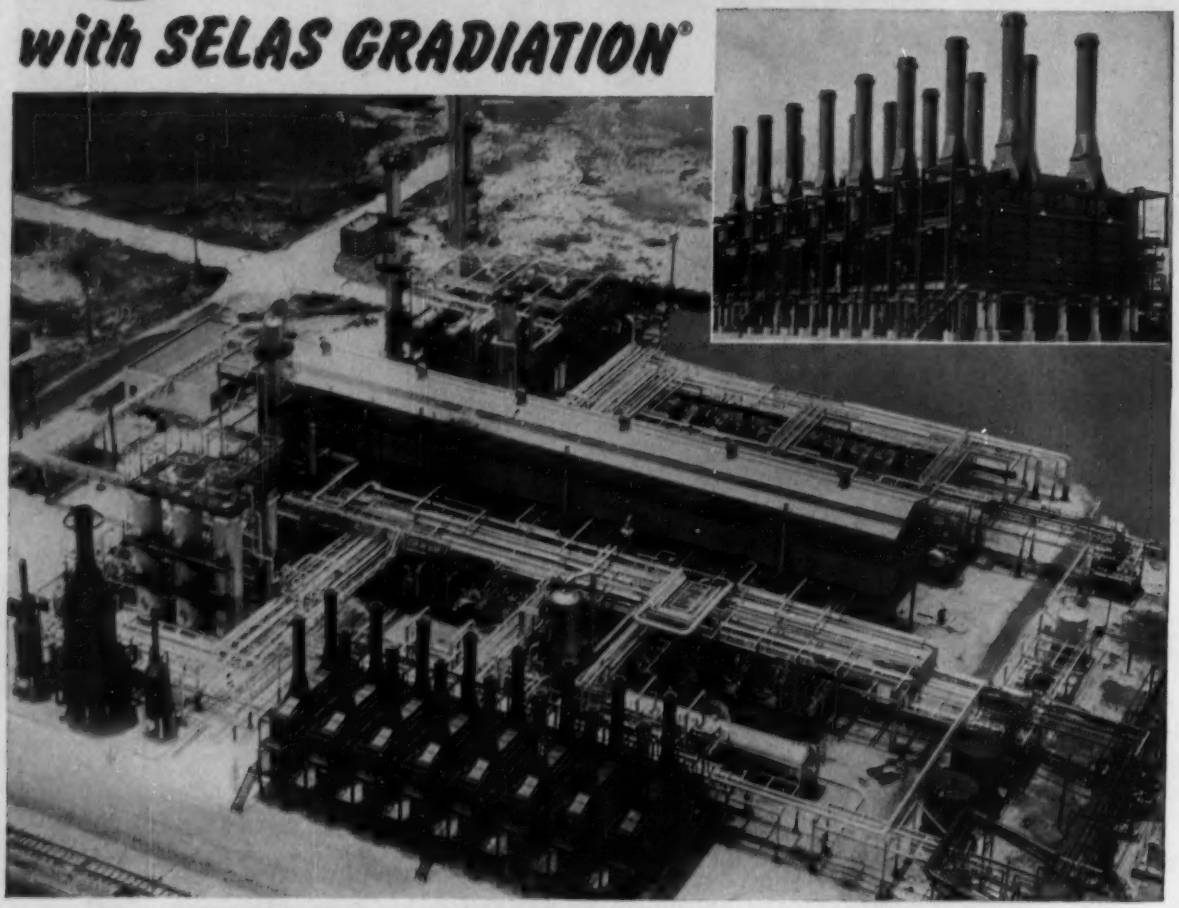

Gulf Oil Corporation's new ethylene plant at Port Arthur, Tex., designed and constructed by Stone & Webster Engineering Corporation. Eight Selas Gradiation heaters are in center foreground.

The world's largest ethylene-producing plant benefits from the versatility of Selas Gradiation heaters. Three separate feed stocks—propane, ethane and propane-propylene mixtures—have been processed interchangeably in all of the eight Selas furnaces.

Operating results on all three feed stocks in the Gulf plant confirm that these Selas heaters provide:

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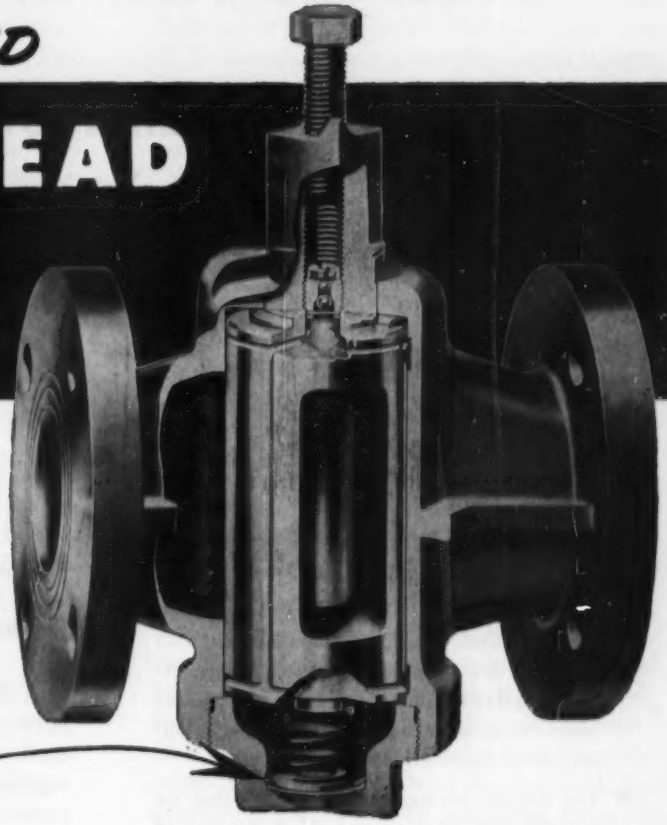

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THE SHORTAGE OF SCIENTISTS AND ENGINEERS:

A Threat to Economic Progress

THERE are two paramount reasons for concern over the serious shortage of scientists and engineers that now confronts the United States:

- The first reason, with which this editorial deals, is that continued expansion of our economy and further increases in our living standards are threatened unless we train more scientists and engineers and use them more effectively.
- The second reason for concern is that we run the risk of falling behind the Soviet Union in the technology so essential to national security. The consequences of losing this race to the Russians are not comforting. (The possibility that this might happen over the next few years was discussed in an earlier editorial in this series.)

The crucial contribution of scientists and engineers to the well-being of the American people has been to find ways of making better use of limited resources, to make equipment more productive, to develop new and better products that enrich our lives, to enable us to live longer and be healthier. They have made this contribution with greater success in the last 15 years than ever before, but it has required progressively more resources and more trained people.

During this 15-year period our annual production of goods and services, in dollars of constant purchasing power, has almost doubled. Since our total population has increased only 25 percent, this has meant a tremendous rise in the economic well-being of the American people as a whole. But in accomplishing this, the number of scientists and engineers has been more than doubled.

Tasks for Research

If the American economy is to continue to grow and if our living standards are to show further improvement, the work of scientists and engineers must be stepped up even more in the years ahead. Unless answers to several pressing problems are found through intensified research efforts, economic progress will become increasingly more difficult.

Productivity per hour of labor must be increased at a faster rate. Improved medical care has greatly increased the number of people who attain retirement age, and sharply higher birth rates since the war will mean larger numbers of children in school and college. Meantime, because of low birth rates during the depression, the number of people reaching working age is not rising nearly so fast. The result is that over the next 20 years our population will increase by about one-third, while the total manhours worked are not expected to increase more than 15 percent. So, simply to maintain the same living standards for a rising population — with no provision for additional improvements — ways must be found to enable each worker to produce for more dependents.

It is primarily to the scientists and engineers that we must look for help in making human labor more productive. This will require enormous increases in our power

resources. We will need to make more effective use of our existing fuel supplies — coal, oil and natural gas. And we will have to devise economically practical means of tapping other energy sources, particularly nuclear power and new rocket fuels.

Also, better ways must be found to use scarce and low-grade raw materials. Thanks to great strides in metallurgy and mining techniques, we are now utilizing sources of copper and iron ore that, for all practical purposes, were not available to us only ten years ago. Similar strides are needed in the mining and processing of bauxite if low-grade domestic ores are to help satisfy a fast-growing market for aluminum. And stubborn technical obstacles in the area of "high temperature" metals—such as nickel, cobalt, columbium, tantalum and titanium — are impeding progress in jet and turbine engines.

These are only a few of the challenging tasks that demand intensified research and engineering activity in the years immediately ahead if the United States is to continue to raise living standards. We need more houses, schools and highways for a rising population, more medical research to reduce further the ravages of illness, more research in chemistry and other sciences to sustain the flow of new and improved products that are so essential an ingredient of our economic progress.

Ceiling on Growth

American industry has indicated that it is ready to meet the challenge and undertake vastly expanded research programs. A recent survey conducted by the McGraw-Hill Department of Economics revealed that total research and development expenditures of American industry were almost $5 billion last year, 29% higher than in 1953. By 1959 business plans to be spending well over $6 billion on research and development. And the total could well prove to be much higher, based on the trend of recent years.

But industry's programs for research and development cannot be carried out unless enough qualified research workers and engineers are available. Ernest R. Breech, chairman of the Ford Motor Company, recently described the supply of engineers as the "ceiling on our future growth." He gave force to his point by announcing: "If 900 qualified engineers were to approach us next week looking for jobs, we would hire every one." The U. S. Bureau of Labor Statistics found in interviews with some 200 large companies at the end of 1954 — a recession year — that at least half were unable to hire enough research scientists and engineers to meet their needs. A third of the companies reported substantial shortages of technical personnel.

The shortage of technically trained people, furthermore, is becoming more acute. The number of engineers and scientists now being graduated is only about enough to cover replacement requirements, while the needs of industry, government and education are mounting every year. According to the best information available — as indicated in the first editorial in this series — these needs are now about twice as great as our current engineering graduating classes and annual production of scientists with Ph. D. degrees.

To perform the research needed to remove roadblocks to our economic progress — and at the same time hold our own in the technology essential to our security as a free nation — we must have an adequate supply of men and women with engineering and scientific training. Instead, we are faced with an acute shortage, now and for several years to come. Reasons for the shortage and proposals for working our way out of the shortage will be discussed in the remaining two editorials in this series.

This is one of a series of editorials prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments of particular concern to the business and professional community served by our industrial and technical publications.

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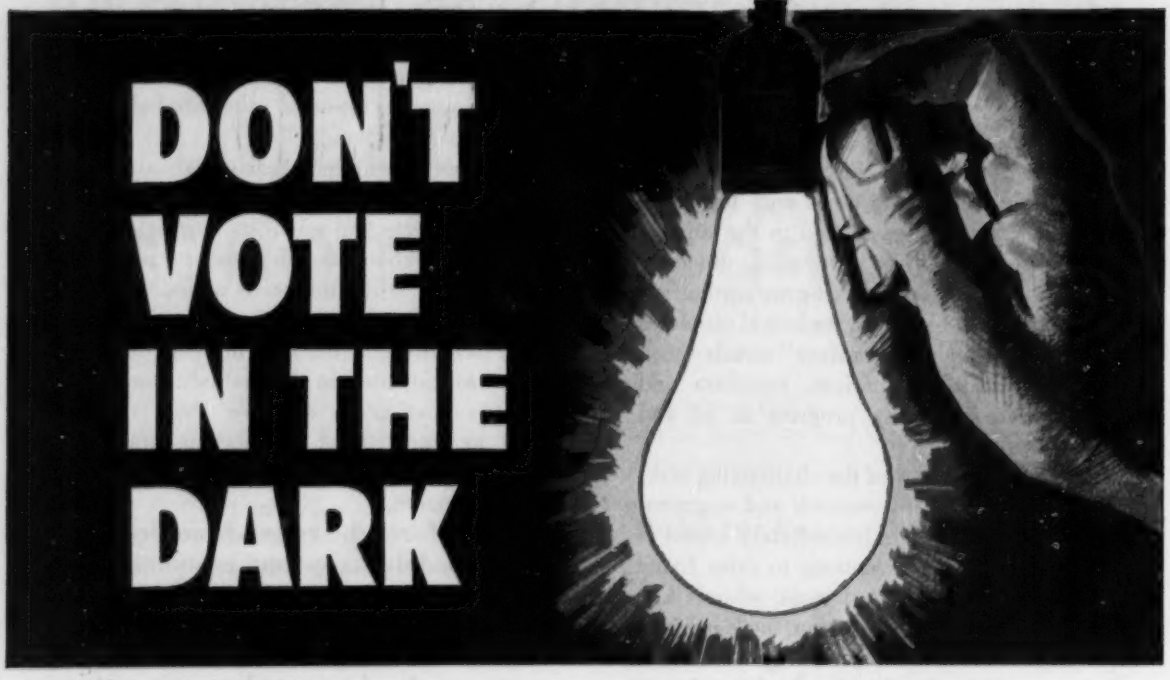

Study the issues and the candidates— and then decide where you stand

You wouldn't buy a new car without at least driving it around the block.

You wouldn't buy a new house without checking up on the neighborhood, the schools, and any back taxes.

So vote—but don't vote in the dark in this exciting election year.

Listen to what candidates are saying on TV and radio.

Read your newspapers—especially the political news and editorial page.

Talk things out with your neighbors over the back fence and at the filling station on the corner. Take part in the discussion group at your church, club, lodge, or school.

Think about the issues and the candidates—and then make up your own mind. Remember, nobody is in that voting booth but you and your conscience. Step behind that curtain with pride on election day. Then vote as a free American.

VOTER'S CHECKLIST

1. Be sure you're registered.

2. Study the issues and candidates. Go to rallies. Ask questions. Read the papers. Listen to speeches.

3. Mark up a sample ballot in advance. (They are published in the papers.)

4. Join your neighbors at the polls on Election Day November 6th.

Is your name in the book?

You can't vote if you're not registered. You lock yourself out of the polls, unless you're a registered voter. And you and only you can get your name in the Registration Book. When they call the roll on election day, will you be there? Do you know anyone who won't?

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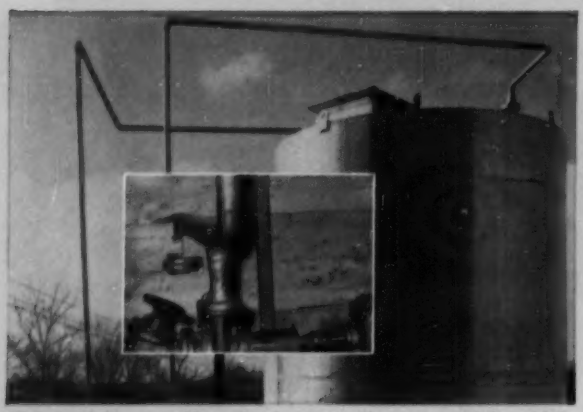
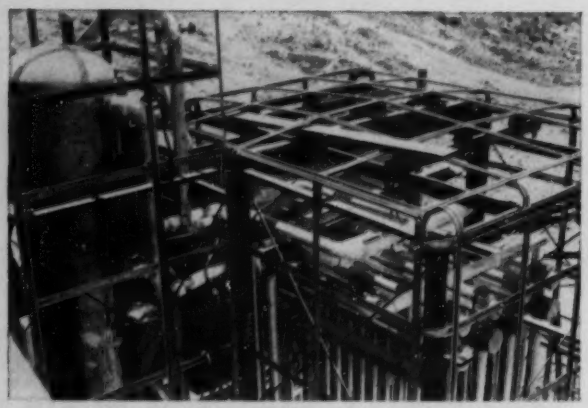
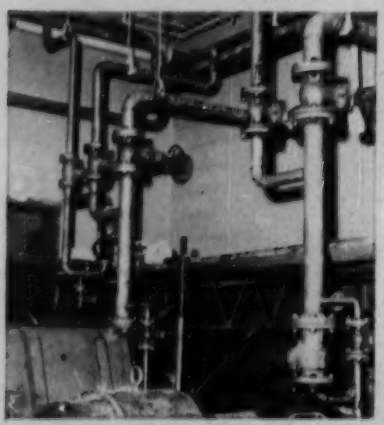


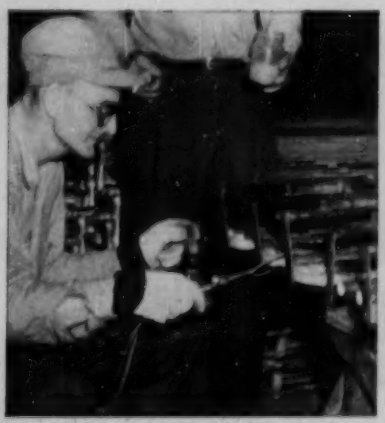
Oleic Acid Storage: Here, 2" aluminum lines carry oleic acid in this installation for a rubber company. TUBE-TURN Aluminum Welding Fittings are used for directional changes. Insert shows a compact combination of these fittings at a pump . . . an elbow, tee, reducer and flange.



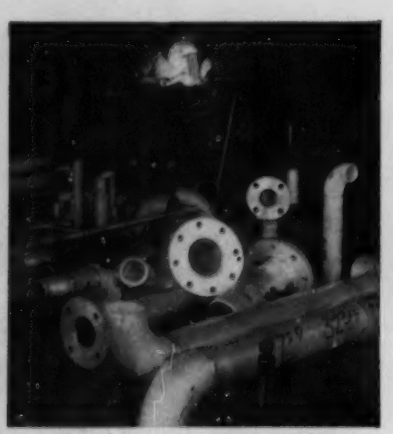
Oxygen Plant: TUBE-TURN Welding Fittings were used throughout this 25 tons-per-day oxygen plant for ore recovery. Here, operating temperatures range from 100°F to −320°F. Picture above shows reversing heat exchangers and fractionating tower prior to being enclosed in insulating shell.



Catalyst Piping: Aluminum piping and fittings were specified for certain services in this new TCR bead catalyst plant to prevent contamination of the catalyst. TUBE-TURN Welding Fittings and Flanges were employed in all aluminum lines from 1" to 10". Result: Lines are permanently leak-proof—maintenance is minimized.



Refinery Wax Coils: Originally, retubing of seven wax sweaters in a large refinery called for coils of another metal. Switch to aluminum piping and TUBE-TURN Welding Fittings saved $50,000 in material costs! Each unit required 900 TUBE-TURN 180° Welding Returns of 1" OD.



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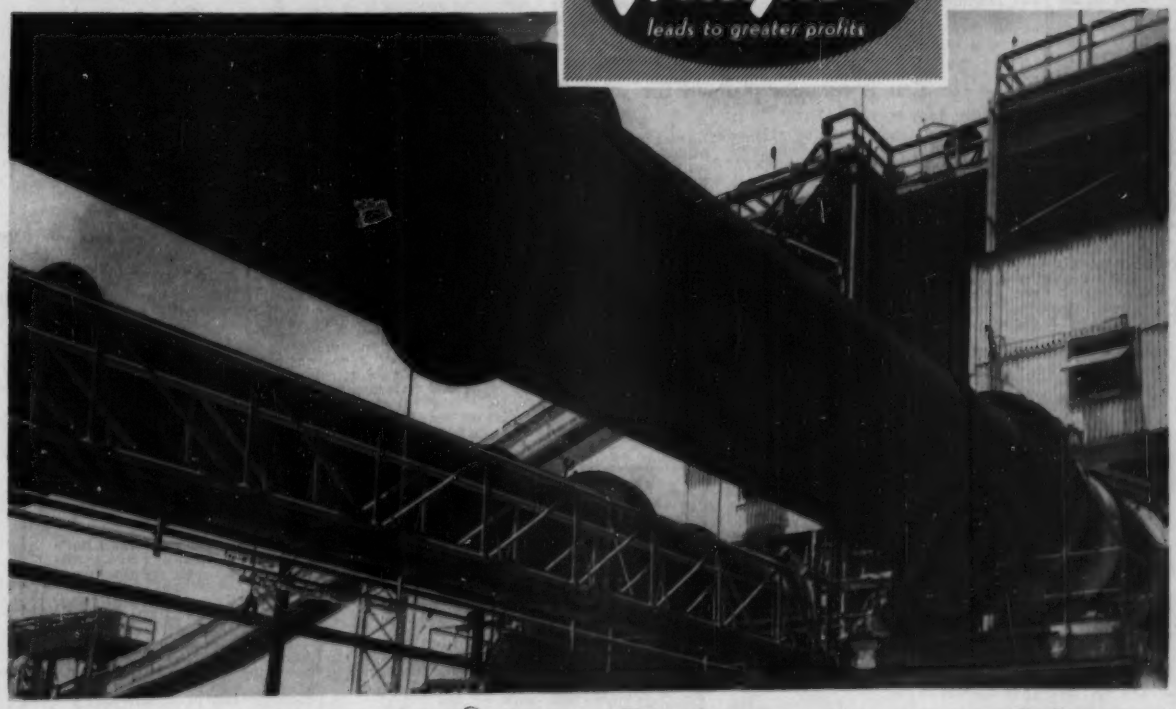

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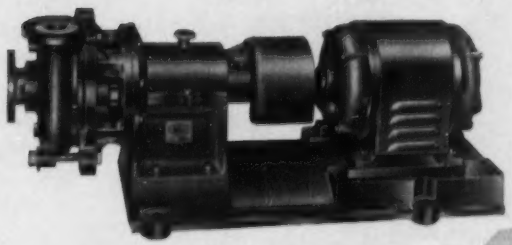

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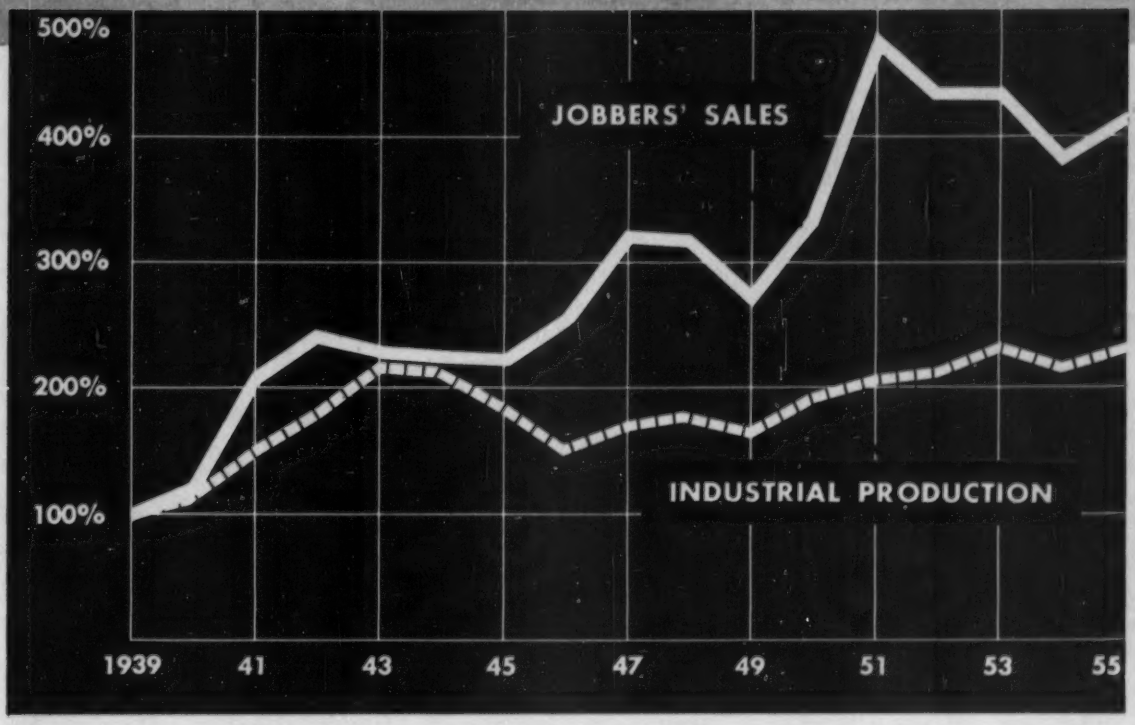

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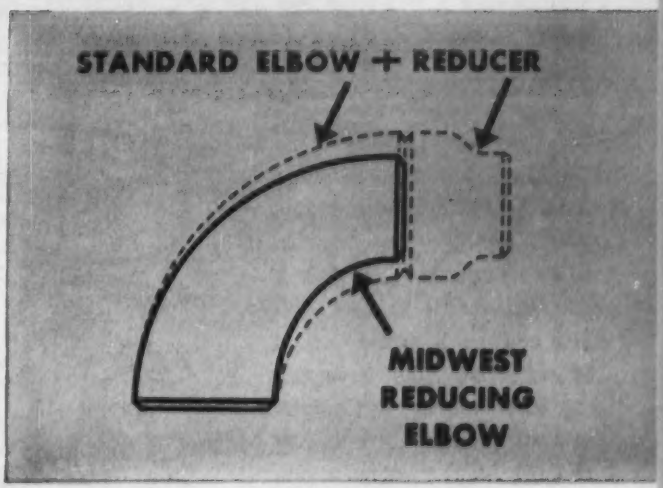

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IMPACT	Light	C-85	88.4	14.25	315,000	600,000	3.75x10-6	77,000,000
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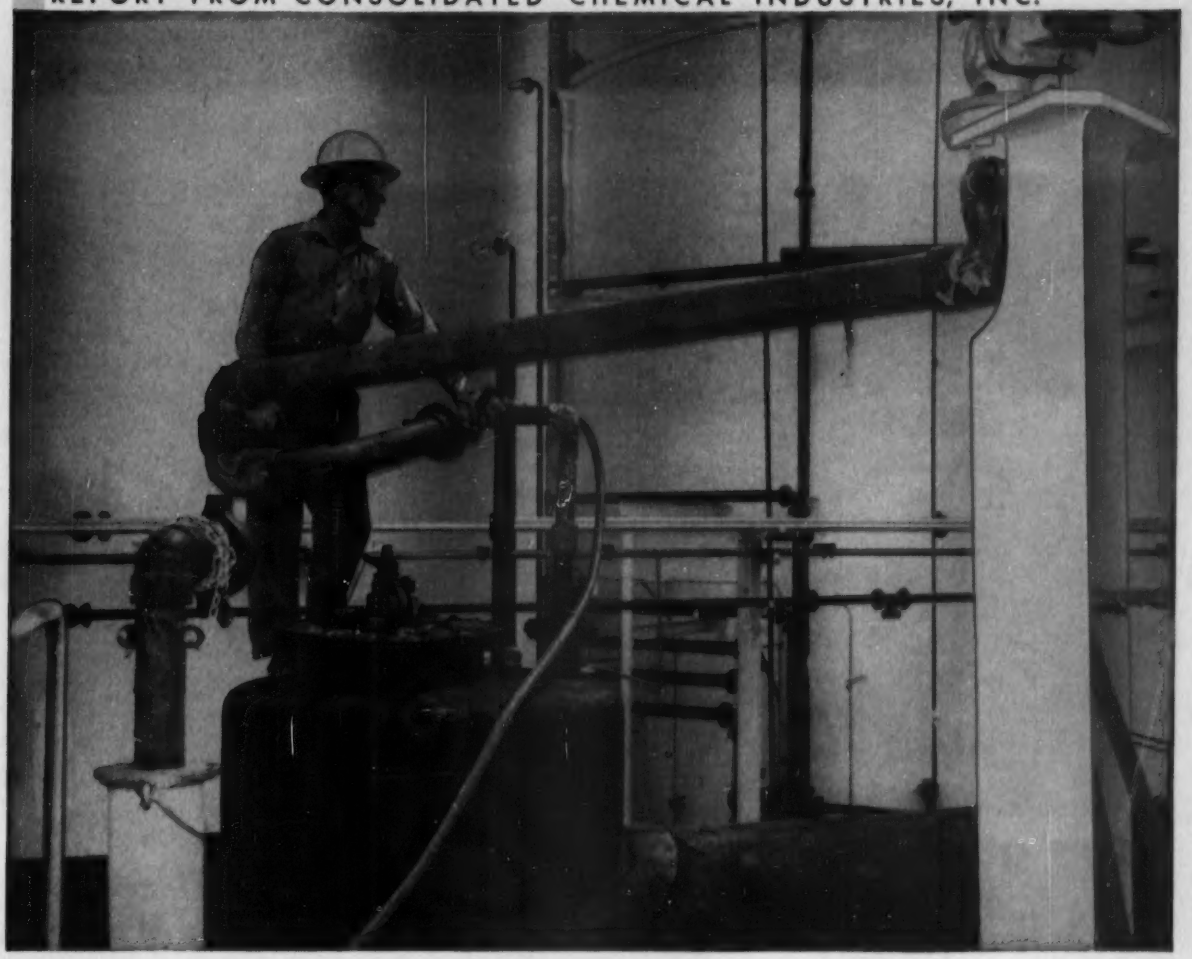

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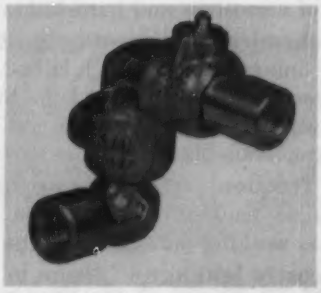

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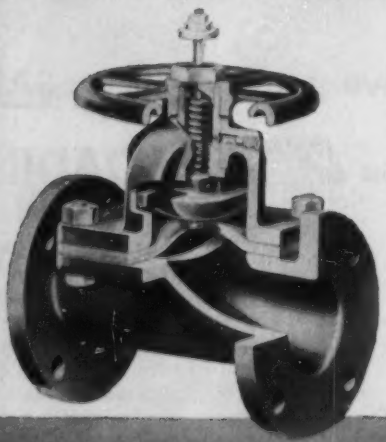

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From chemical, fertilizer and many other kinds of plants come words of praise and satisfaction over the performance of the new-design model HA "PAYLOADER". Built to scoop-up and carry more material for its weight than any tractor-shovel near its class, the new HA is way ahead of the field in the *kinds* of work it can do — in the *amount* of work it can do.

Torque-converter drive; full-reversing transmission; 40-degree bucket tip-back at ground; closed, pressure-controlled hydraulic system with built-in shock absorber . . . these are but a few of the many tried and proven plus values in the new HA that contribute to its leadership in performance, low maintenance and long life. Your Hough Distributor is eager to show you what the new HA or a larger "PAYLOADER" can do for you.

PAYLOADER®
MANUFACTURED BY
THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.
SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY

For higher lifts and more production a bigger front wheel drive unit — model HAH 1 cu. yd. capacity.

THE FRANK G. HOUGH CO.
754 Sunnyside Ave., Libertyville, Ill.

- ☐ Send data on Model HA (1½ cu. ft.)
- ☐ Send data on Model HAH (1 cu. yd.)
- ☐ On larger models up to 2¼ cu. yd.

Name
Title
Company
Street
City
State

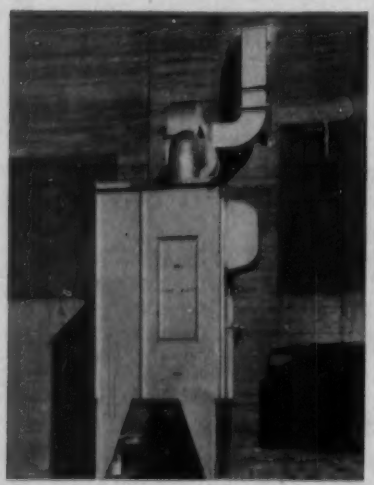
DUST and FUME topics

WHEELABRATOR CORPORATION — Mishawaka, Indiana

"ULTRA-FILTRATION" PROVIDES SUPER-CLEAN AIR AT A NEW LOW COST

OPERATES 24 HOURS A DAY; MAINTENANCE SLIGHT IN FIRST YEAR

Constant demand for super-clean air is created in the hammer mill room at Columbia-Geneva Steel Company, where two 500 H.P. synchronous motors operate 168 hours a week. Wheelabrator "Ultra - Filtration" has provided clean air with virtually no maintenance costs in its first year, as opposed to poor performance and high maintenance costs experienced with the equipment used previously.

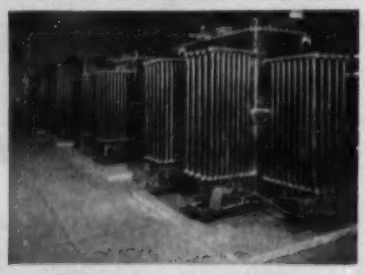


WHEELABRATOR® DUSTUBE COLLECTOR ELIMINATES INSTRUMENT REPAIR

These instruments, in the sinter plant control room at Columbia-Geneva Steel Company, were always in need of repair until Wheelabrator "Ultra - Filtration" was installed to filter the air entering the room from the mill.

The control room is in a very dusty location in the plant. It is near the sinter machine and is subject to dust from transfer belts that run above and below the room.

In the six months the Wheelabrator unit has been operating, dust has ceased to be a problem in the operation and maintenance of recording and control instruments.



CLEANS ATMOSPHERIC AIR FOR SUB-STATION

Dust from the ground, crushing and screening of iron ore and handling of coal is removed from air entering the sinter plant substation housing these large transformers and electrical control panels. The efficiency of Wheelabrator "Ultra-Filtration" provides the thoroughly clean air required in this room.

NEW DUST CONTROL PRINCIPLE GIVES SUPER CLEAN AIR THROUGH "ULTRA-FILTRATION"

An inexpensive filter aid to precoat the filtering surface of Wheelabrator cloth tubes provides highly-efficient matrix upon which fine atmospheric dust is collected with a new and unusually high efficiency.

"Ultra-Filtration" with Wheelabrator collectors provides superclean air for ventilation, cooling or air conditioning of electrical control rooms, laboratories, manufacturing areas, etc. Write for complete details.

WHEELABRATOR
CORPORATION

347 S. Byrkit Street, Mishawaka, Indiana

For Special Service

EQUIPPED WITH SPECIAL COATED PLUG

APPROVED BY UNDERWRITERS' LABORATORIES, INC.

Wedgeplug Steel Valves, equipped with Special-Coated Plug, are setting new standards for valve performance. The Special Coating, which is bonded to the metal, assures a tight seal and is highly resistant to abrasion and corrosion. Ideal for handling Air; Natural Gas; Saturated Steam; Water; Alcohols; Solutions of various Organic and Inorganic Acids; Alkaline Solutions; Saturated Solutions of Acidic, Alkaline, and Neutral Salts; Ethers; Animal, Vegetable, and Petroleum Oils; Turpentine; Gasoline, Kerosene, Propane, Butane, and other Hydrocarbons—also certain Sulphur Derivatives; many Solvents and Chemicals. . . . Recommended for Operating Temperatures between —40°F. and +220°F. Available in 150 lb. and 300 lb.; Sizes 2 to 6 inches; Wrench-operated or Handwheel-operated. Write for Coated-Plug Folder.

Available from Stock, with *Hycar-Coated Plug

Wedgeplug Performance Saves Money For You

WEDGEPLUG
NON-LUBRICATED
STEEL PLUG VALVES

WEDGEPLUG VALVE COMPANY, INC.
An Affiliate of
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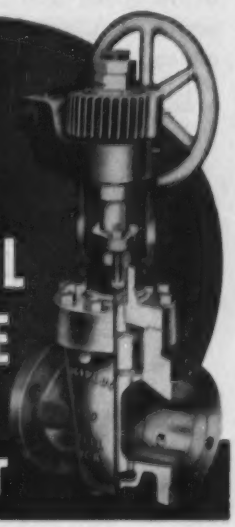
*Hycar is the trade-name of the Product made by B. F. Goodrich Chemical Co., used in coating Plug.

for GENERAL SERVICE



NEEDS NO PLUG LUBRICANT

Gardner-Denver . . . Serving the World's Basic Industries

4" BL Centrifugal Pump

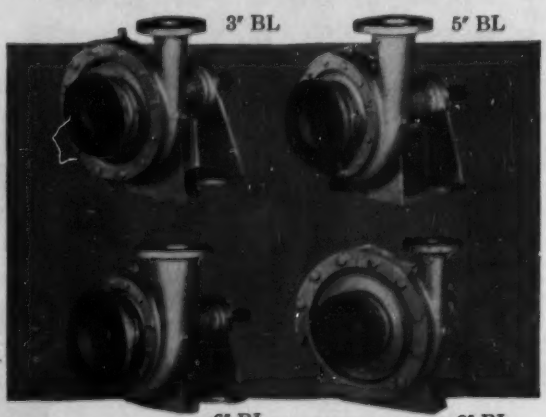
New Gardner-Denver BL Pumps

. . . stay efficient even when volume on head fluctuates

HERE'S NEWS FOR PUMP ENGINEERS: These new Gardner-Denver Centrifugal Pumps are designed to deliver peak performance over broader ranges of service conditions. BL pumps take variations—either in the head or water volume.

Each size (there are five to choose from) handles a wider-than-usual range of pressures and capacities.

Each has heavy-duty ball bearings, factory lubricated . . . extra large shaft to assure continual alignment . . . strong supporting frame . . . a trouble-free mechanical seal. Bulletin A-8 gives all the facts.



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cold water softening and clarification

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It is used extensively in the chemical, paper, plating and processing fields. Cochrane Reactors are used for the recovery of fiber from white water in paper mills. They are an accepted pre-treatment for demineralization of boiler feed water and of water used in tin plating. They are also widely used for water clarification in oil field flooding.

The "catalytic effect" offered by the Cochrane design accelerates growth of newly-formed precipitates, producing clear water faster and with less chemical, thereby providing savings in investment in tank size requirements as well as in operating cost.

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Ad 7.01

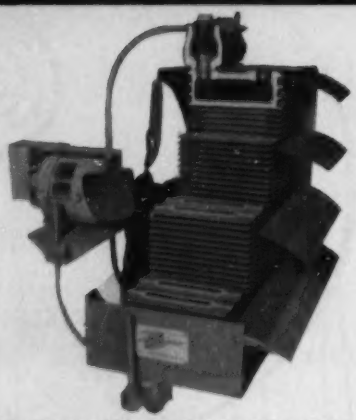
corrosion

EXTERNAL - from contaminated air

INTERNAL - from electrolytic action

ends

When your UNIT HEATERS are GRID CAST IRON CONSTRUCTION - and HERE'S WHY -



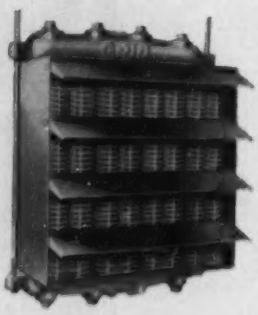
GRID heating sections and headers are made of high-test cast iron . . . no external corrosion from acid fumes.

All metals in contact with steam are similar . . . no electrolytic action internally . . . no internal corrosion.

GRID construction ends your unit heater maintenance problems—because GRID will operate on steam pressures up to 250 lbs. P.S.I. . . . 450° temperature . . . no pressure-reducing valves needed. No soldered, brazed, welded or expanded connections . . . a specially designed threaded nipple provides a leak proof joint (see illustration).

GRID design gives you maximum heating performance because—

GRID provides more air changes at lower outlet temperatures . . . carefully selected motor speeds and fan capacities positively deliver warm, comfortable air in ample volume to floor level . . . no wasted heat through stratification.



GRID installations save you money as GRID requires no maintenance . . . is practically self-cleaning (note wide fin spacing in illustration). GRID provides long service life . . . units installed in 1929 are still operating. No ordinary unit heater approaches GRID's record for continuous trouble-free heating service.

Get the complete story on GRID Unit Heaters, GRID Blast Heaters and GRID Radiation for chemical plant use. Write for your copy today!

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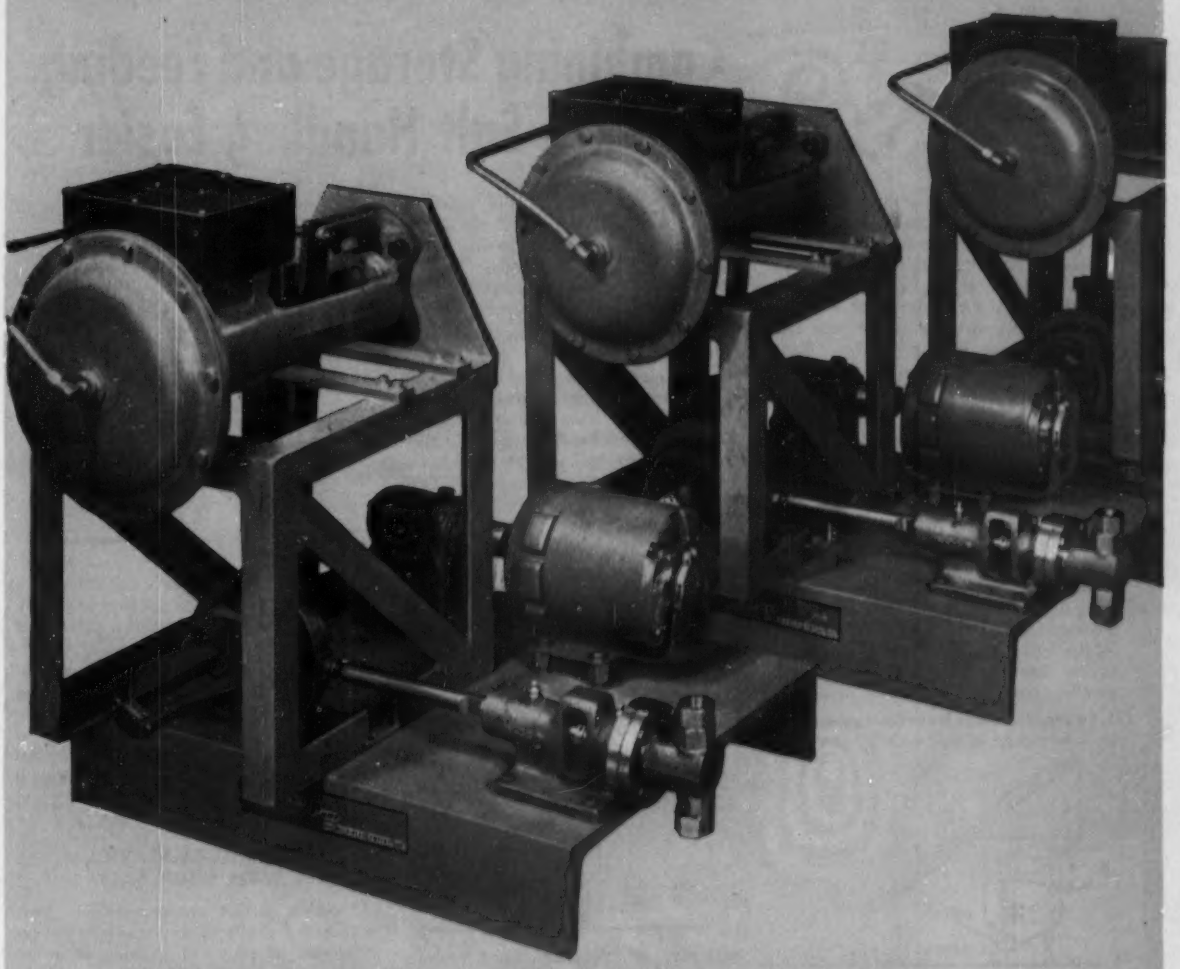
REPRESENTATIVES IN ALL PRINCIPAL CITIES

Pumping Corrosion Inhibitors..



..with metering accuracy of 0.2%

thanks to **PHILATROL***

AUTOMATIC CAPACITY CONTROL

* Illustrated, pneumatically motivated with built-in square root extractor requiring 3 to 15 lb. signal. Also available electrically motivated—50 or 100 ohm slide wire. Hydraulically motivated —50 to 100 p.s.i. hydraulic fluid.

PHILADELPHIA PUMPS

PHILADELPHIA PUMP & MACHINERY CO. / 1513 Race St., Phila., Pa. / Subsidiary of American Meter Co.

Using Salt Efficiently

by **INTERNATIONAL SALT COMPANY, INC.**—America's largest producer of salt

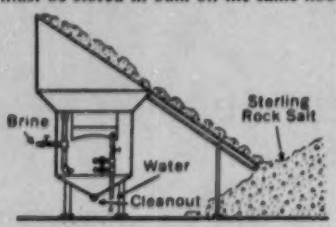
Combining Storage and Feeding Makes Salt Handling Easier

To save both time and manpower in salt handling—many plants have installed salt-storage units which feed directly into a salt dissolver. These units are particularly useful in plants where large tonnages of salt are consumed every day. But even in smaller plants, combination storage and feeding units are proving valuable. This is because they cut down on the amount of floor space needed to store salt.

In plants where floor space is at a premium, salt is often purchased in bags to permit high stacking. Here, too, combination storage and feeding units can produce substantial savings. They permit the purchase of economical bulk rock salt—and reduce salt-handling costs to a minimum.

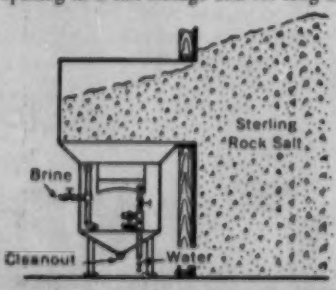
What about one of these units for your plant? Here are six of the most practical designs for combining salt storage and feeding. One of them—or an adaptation of the basic design—may be effective in saving floor space and lowering salt-handling costs for you.

1. Filling dissolver from floor pile. If salt must be stored in bulk on the same floor



as the dissolver (all dissolvers shown here are International's famous Sterling Model Lixator), an excellent feeding device is a portable belt conveyor. The best type for moving salt is made of aluminum with a rubber belt, and is between 16′ and 20′ long. The same conveyor moves salt not only from a floor pile into the Lixator, but also from a car or truck into the plant.

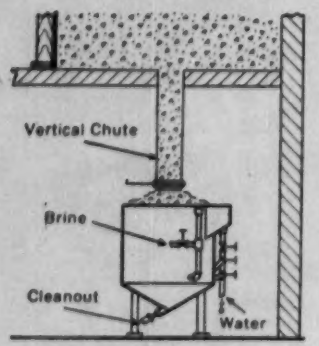
2. Wall-type hopper, bolted directly to an opening in a salt-storage bin. As long as



the salt supply in the bin is sufficiently high to permit gravity flow into the Lixator hopper, feeding will be automatic. When salt supply is no longer self-feeding, the operator stands on the salt in the bin and shovels directly into the hopper.

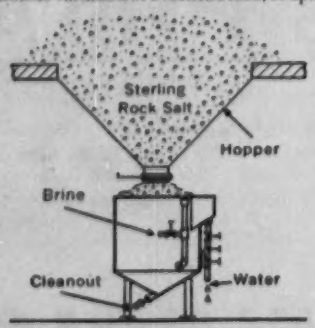
3. Overhead storage with gravity feed into hopper. This design is often used when uninterrupted salt feed is needed, but the storage floor has relatively little salt capacity. A cylindrical-type hopper directly under the hatch holds a large amount of salt for feeding the Lixator—and acts as a substantial secondary storage unit. Ordinarily, though, if salt can be stored above the Lixator, the next design is preferable.

4. Overhead storage with vertical chute. This direct-feed unit is a practical, econom-



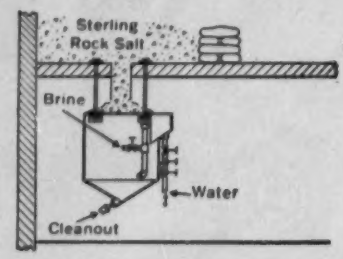
ical way of operating the Lixator. If storage capacity on floor above is large enough, no hopper is needed, which means a considerable saving. Feed is automatic because of angle of repose for salt.

5. Pyramid-type hopper design. This is another variation of overhead feed, coupled



with large storage capacity. But if storage space on floor above is limited, this design is also practical. Salt can simply be dropped into the hopper through a large hatch with a removable cover.

6. Lixator hung above floor, to save floor space. A very desirable design when



floor space is at a premium. Design here also shows use of a few salt bags to act as a storage-bin wall—in lieu of a permanent bin structure.

One final note about the equipment shown here. All Lixators operate on exactly the same principle. They vary only in size and capacity, and in methods of delivering salt to the dissolver unit. All Lixator designs are exclusive International Salt Co. developments, properly protected by patents and patents pending.

TECHNICAL SERVICE WITH YOUR SALT

Through skilled and experienced "Salt Specialists," International can help you get greater efficiency and economy from the salt you use. International produces both Sterling Evaporated and Sterling Rock Salt in all types and sizes. And we also make automatic dissolvers in metal or plastic for both kinds of salt. So we can recommend the type and size of salt most perfectly suited to your needs.

If you'd like the assistance of an International "Salt Specialist" on any problem concerning salt or brine—or further information on salt storage and methods of feeding salt—just contact your nearest International sales office.

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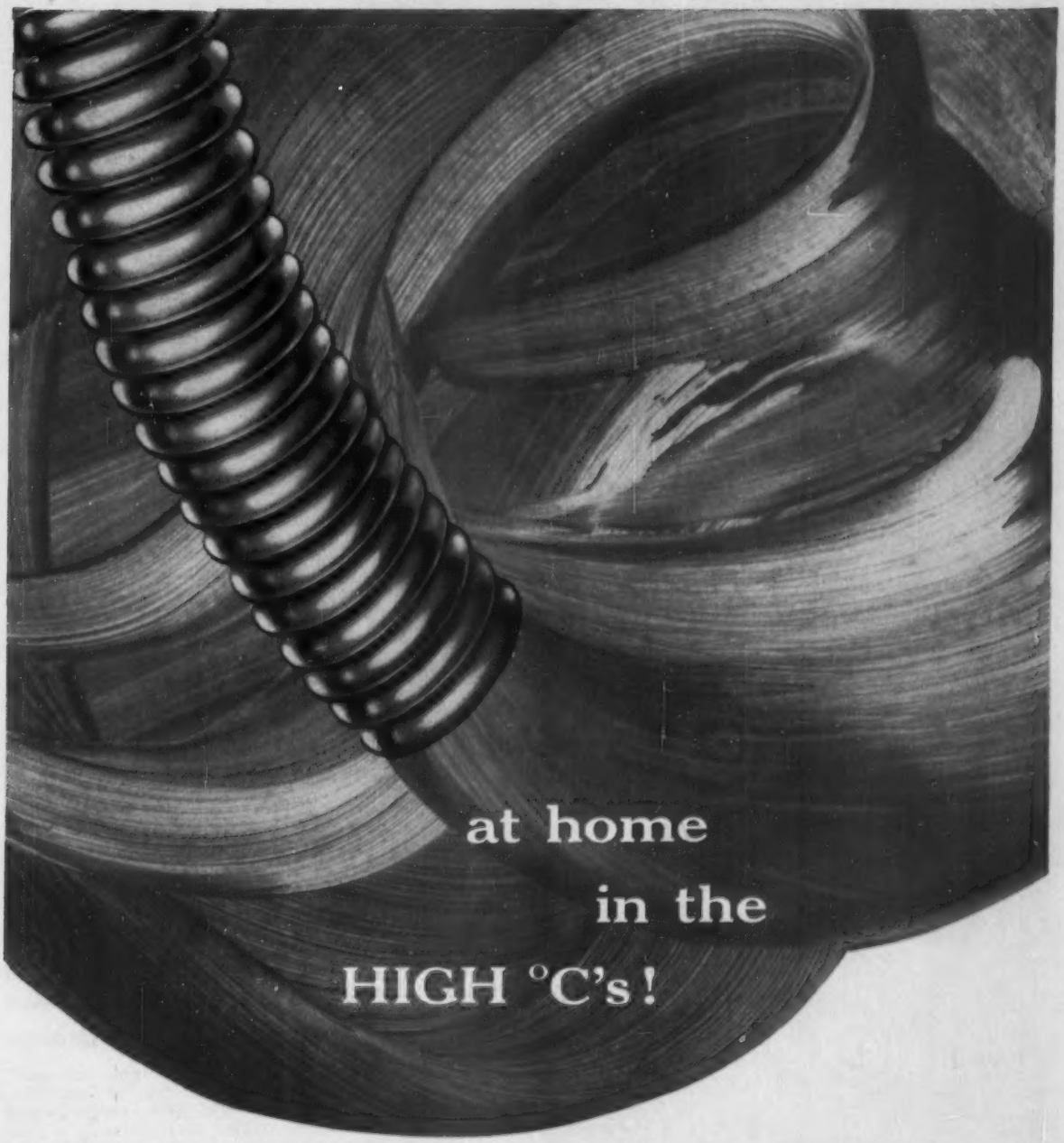
PRODUCT OF INTERNATIONAL SALT CO., INC.



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Available in sizes ¼"-4" I.D. inclusive with appropriate fittings. Produced in various alloys of stainless steel —— in monel, bronze, and carbon steel. Write for Bulletin 21-A. See our Catalog in Sweet's File for Product Designers.

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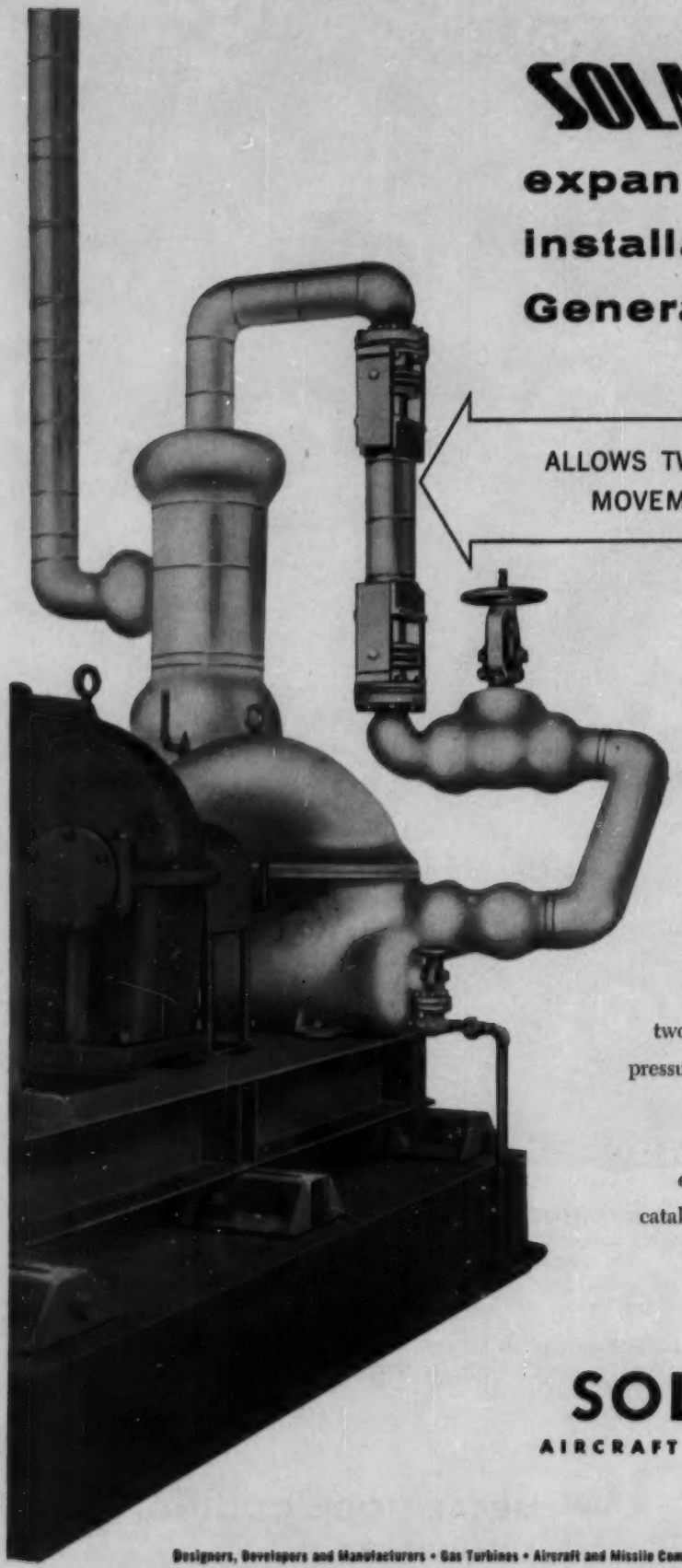

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expansion joint installation for General Petroleum

ALLOWS TWELVE INCH LATERAL MOVEMENT OF TURBINE

PROVIDING FLEXIBILITY for the steam connection to this turbine assembly was a problem at General Petroleum. The turbine had to be movable to permit installation and take up of drive belts to the compressor unit. A practical solution was found in the use of a 3 in. offset Sola-Flex hinged joint, 42 in. long. The bellows allows a 6 in. movement in two directions—and stands up under rugged pressure and temperature conditions. No matter what kind of expansion joints you need, Solar can build them—ruggedly and economically. Ask for the latest Sola-Flex catalog. Dept. C-46, Solar Aircraft Company, San Diego 12, California.

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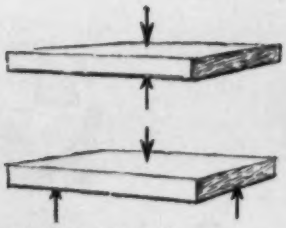
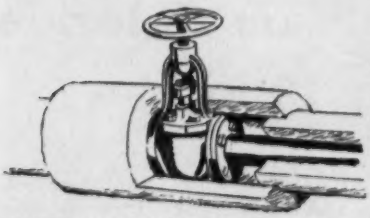
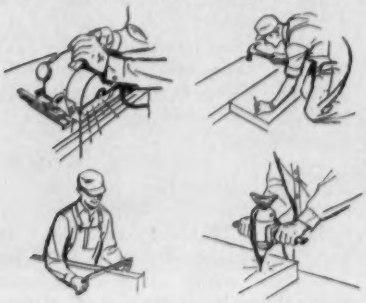


Unequaled compressive and flexural strength!



Can be removed for easy line inspection . . . replaced without damage, waste!



Saw it . . . nail it . . . shave it . . . drill it!

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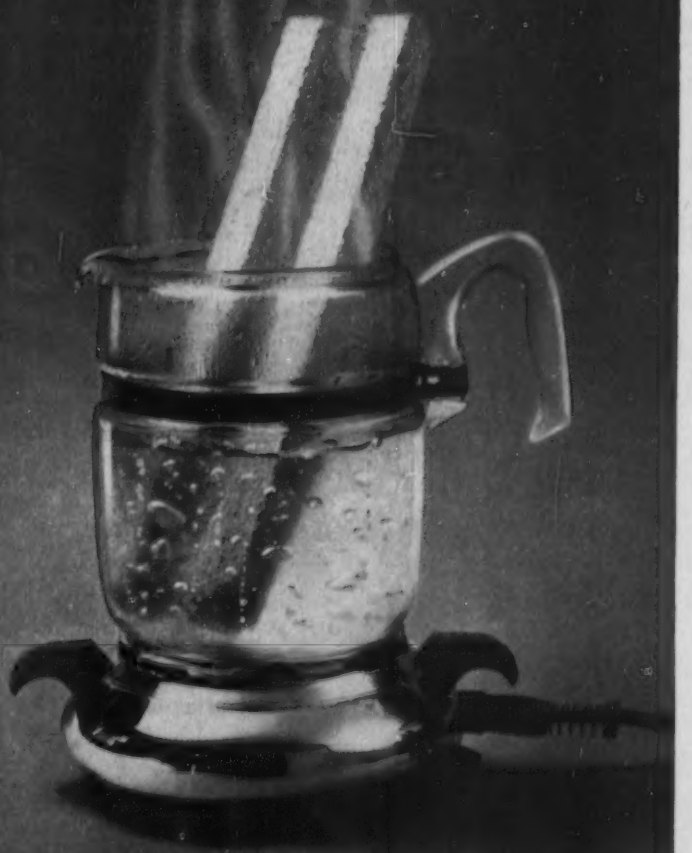

for stability!

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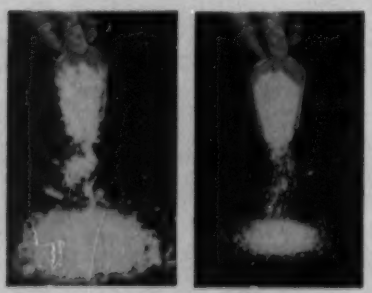
Caustic Soda
Aluminum Chloride
Sulfur Chlorides

He treats our caustic drums rough. A customer in the Pennsylvania oil fields made our salesman wince.

Said he likes our flake caustic soda drums, because they make it easy to distribute caustic in the field. He just shoves the drums off the tailgate of his truck, lets them bounce. He's been doing it for some time without handling losses.

We certainly don't advise this procedure, but it does provide a dramatic testimonial. Six lugs grip the lid of every drum of Hooker flake caustic soda—the best way we've found to keep the caustic dry and pure for your processing or repackaging.

The drum comes to you full of clean, uniform flakes—regular, fine, or crystal—or powdered caustic. The picture below demonstrates how dust-free the flakes are. The coupon offers a helpful booklet on buying caustic soda.



Why we air-condition our aluminum chloride. Even slightly humid air reacts swiftly with aluminum chloride. When it does, the crystals of this sensitive chemical lose their shape, and most of their punch as catalysts.

We avoid such damage to our aluminum chloride by using a special packaging room that is air-conditioned. It gives us complete control over humidity. Regardless of outside weather conditions, we can package aluminum chloride all year 'round.

To you the room means a continuous, dependable supply of full-strength aluminum chloride. And you always get the size you want for your process.

Speaking of size, you have a choice of four from Hooker—extra fine, fine and coarse grinds, and coarse screened. Send the coupon for a data sheet that gives complete specifications on all four or write today on your business letterhead.

How to dry paint in 2 seconds. Many paints, inks, and varnishes take from 24 hours to a week to dry thoroughly.

But pass them through sulfur dichloride vapor, and they dry before your eyes—in from 2 to 20 seconds. This drying process works on paper, wood, cloth, metal, glass, plastics.

Maybe there's a place for superfast drying in your company. If you think so, write us for the name of the process licensor.

Perhaps you're already *using* SCl_2 in a less glamorous but equally useful way. Whatever the need, you can answer it by specifying Hooker sulfur dichloride.

And if it's chlorination you're doing, you might be happy, to know we also make its versatile chemical cousins, sulfur monochloride, sulfuryl chloride, and thionyl chloride.

Sources we've checked indicate we're the only producers of all four of these chlorides. We'll be happy to provide (a) data sheets on any of them, if you'll check the coupon; (b) samples, if you'll just write on your letterhead outlining your needs.

Check items you'd like to receive:

- ☐ **Caustic Soda Buyer's Guide** • A helpful pocket-size booklet full of information and pictures on forms and sizes; shipping methods and containers; the economics of 50% vs. 73% solutions (with nomograph to help decide which is your best buy); and technical service.

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- ☐ Aluminum choride
- ☐ Caustic soda (standard grade)
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- ☐ Sulfur dichloride
- ☐ Sulfur monochloride
- ☐ Sulfuryl chloride
- ☐ Thionyl chloride

Clip and mail with your name, title, and address.

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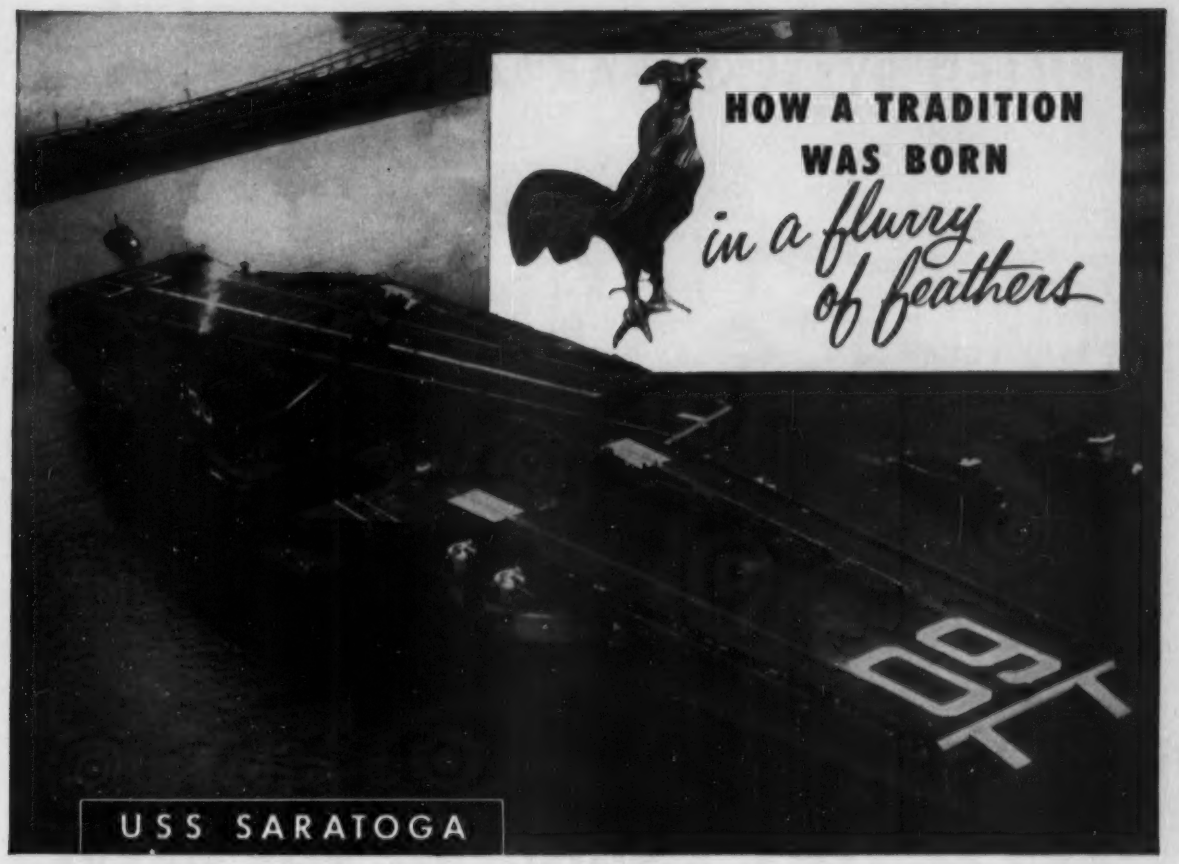


The symbol, and the spirit, of the fighting gamecock lives on with the commissioning of the powerful aircraft carrier, *USS Saratoga.*

The incident which gave birth to this 142 year old Navy tradition took place on the decks of the first *Saratoga* as she closed for action against four men-o'-war in 1812. In the opening minutes of the engagement an enemy ball landed on deck—crashing into a coop containing a gamecock brought aboard by a sailor.

With a flurry of feathers, the startled bird flew to the rail and, as if expressing his personal indignation, crowed lustily and defiantly. Taking this as an omen of good luck, the outnumbered and outgunned American ship entered the battle with new courage and completely won the day.

The Navy's newest aircraft carrier is the fourth ship to bear the name *Saratoga* and adopt its fighting symbol. As aboard its sister aircraft carriers, the USS Forrestal, USS Independence*, and USS Ranger*, Walworth Valves and Fittings are installed. We are proud of the many contributions that our products and engineering skills have made to these outstanding vessels.

Walworth products installed aboard these ships include Pressure-Seal Cast Steel Gate, Globe, and Angle Valves, Fabricated Cast Steel Manifold Valves, Cast Steel Y-Globe and Angle Valves, Bronze Gate, Globe, Angle, and Check Valves and thousands of Walworth pipe fittings including Walseal® Fittings, Flanges, and Unions.

*Now under construction.

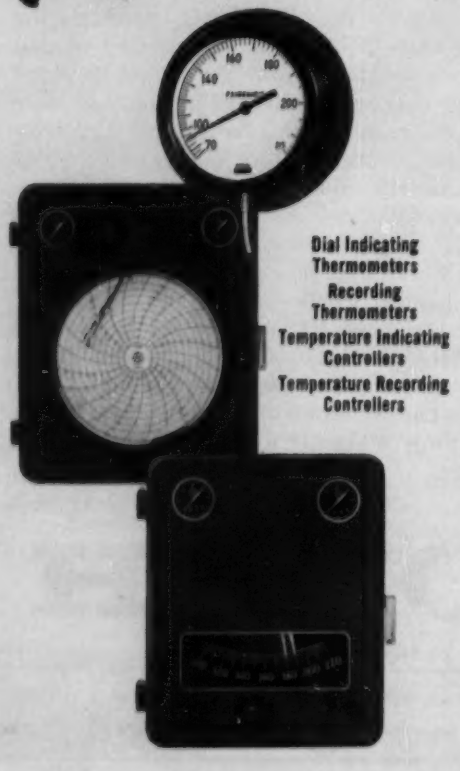
WALWORTH

60 East 42nd Street, New York 17, New York

SUBSIDIARIES: ALLOY STEEL PRODUCTS CO. · CONOFLOW CORPORATION · M & H VALVE & FITTINGS CO. · SOUTHWEST FABRICATING & WELDING CO., INC. · WALWORTH COMPANY OF CANADA, LTD.

FILLED SYSTEM LEAKAGE

Now A THING OF THE PAST!



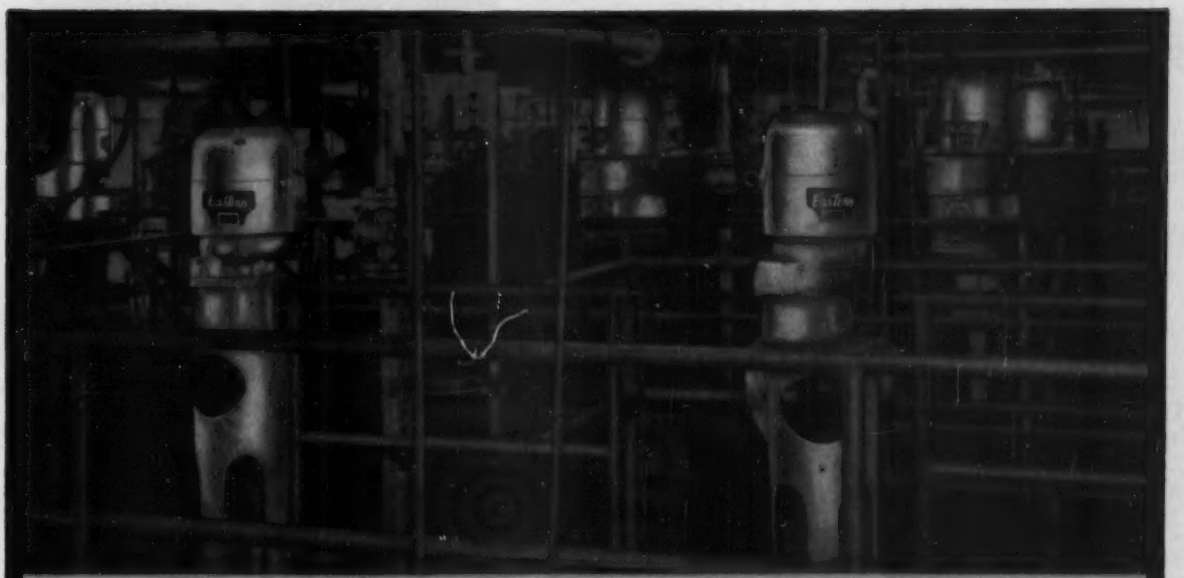
Dial Indicating Thermometers
Recording Thermometers
Temperature Indicating Controllers
Temperature Recording Controllers

The statement is worth repeating. *"Filled system leakage is now a thing of the past!"*

How come? It wasn't come by easily! It required intensive investigation and development here at Weston . . . involving design, materials, dimensioning, finishing, and manufacturing techniques and controls. The result was a new system that is far outperforming any filled system previously known.

The proof? In five long years . . . from the day the new WESTON system was introduced, *no filled system has failed in service.* The development of this new system is one more example of the forward thinking, technical proficiency and production skills that have made Weston world's leader in precise instrumentation. Catalog M2 is available for the asking. *Weston Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N.J.* A subsidiary of Daystrom, Incorporated.

WESTON
Instruments
—TO INDICATE, RECORD, CONTROL



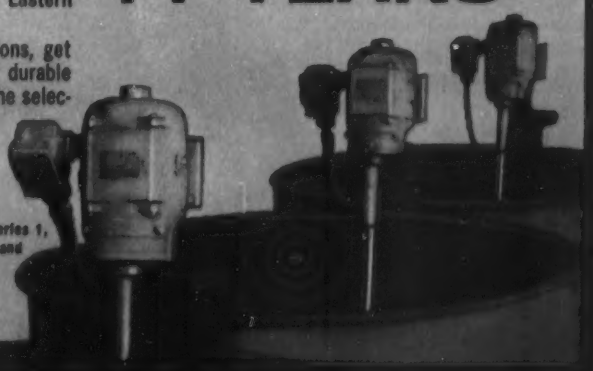
Back in 1942 the new synthetic rubber program was of urgent importance to the war effort. Naugatuck Chemical Co., now a Division of U.S. Rubber Co., developed processes that included fluid mixing applications. Many of Naugatuck's top-entering and portable mixers were engineered and manufactured by Eastern Industries specifically for these processes.

After fourteen years of hard, continuous service, these Eastern Mixers continue proving their built-in **reliability.**

If you have a process entailing critical operating conditions, get a long-term guarantee on your investment by selecting durable Eastern Mixers. Eastern offers engineering assistance in the selection of proper mixers from the complete Eastern line.

CONTINUOUS SERVICE . . .

14 YEARS



Eastern
INDUSTRIES, INC.
Mixer Division
Regent Street
Norwalk, Conn.

Write for Catalog Series 1, containing product and engineering data.

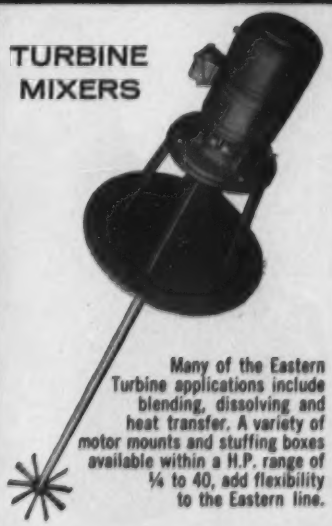
PORTABLE MIXERS

Various models offer a choice of speeds and H.P. dependent upon the consistencies of fluids. All models are available with shafts and propellers of various alloys. Single and dual propellers, and a wide choice of motors give flexibility to handle the most critical of operating conditions.

TOP & SIDE ENTERING MIXERS

Heavy-duty models cover the range from ¼ to 30 H.P., at speeds from 280 to 1725 R.P.M. Versatile in design . . . rugged in performance, these mixers offer a wide choice in mounting arrangements and motors. All side entering models are available with stuffing boxes which can be repacked with a full tank.

TURBINE MIXERS



Many of the Eastern Turbine applications include blending, dissolving and heat transfer. A variety of motor mounts and stuffing boxes available within a H.P. range of ¼ to 40, add flexibility to the Eastern line.

For Acid Gases . . .
There's Engineered
Eye and Respiratory Protection
in this Versatile Combination!

SAFETY PRODUCTS

The Goggle — *Frame* is molded from non-irritating, acid-resisting neoprene. Air-tight fit helps prevent acid or dust leakage. *Bridge* and other face-contacting edges have broad bearing surfaces for real comfort. May be worn over personal glasses. *Vents* with fine mesh stainless steel screenings reduce fogging possibility — and are designed to prevent foreign matter reaching eyes. Vents are easily replaceable individually. *Lenses* are large, easily replaceable, impact resistant acetate — conform to high safety and optical standards. Vision is exceptionally wide-angle. Available in clear or green. *Headband* — Rubber, extra wide, easily adjustable.

AO 700A
RUBBER FRAME GOGGLE

AO R5052 RESPIRATOR

The Respirator — One of American Optical's popular twin cartridge R5000 Series. Uses R52 cartridges for protection against low concentrations of acid gases, fumes and mists such as sulphuric acid, hydrogen chloride, nitric acid. Protects against fumes from plating and pickling tanks and similar hazards.

NOTE: This respirator can be quickly converted to an organic vapor respirator, a combined organic vapor and acid gas respirator, or an ammonia respirator by replacing the R52 cartridge with the recommended AO cartridge for the particular hazard or hazards.

Ask Your AO Safety Products Representative

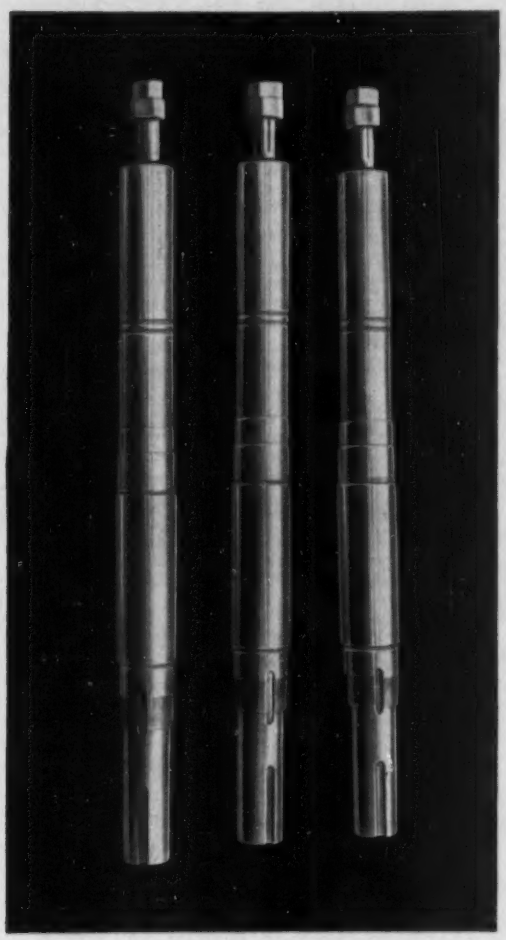
American Optical
SAFETY PRODUCTS DIVISION

SOUTHBRIDGE, MASSACHUSETTS • BRANCHES IN PRINCIPAL CITIES

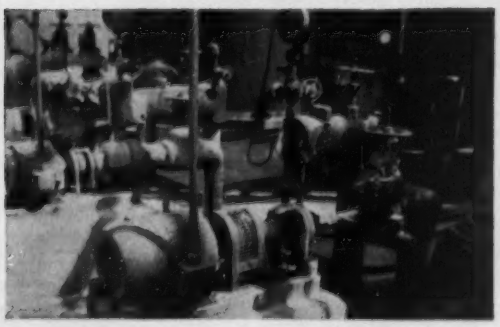
Always insist on AO Trademarked Safety Products

Refinery Reports Pump Shafts Made of Armco 17-4 PH

LAST LONGER . . . COST LESS



Armco 17-4 PH Stainless shafts used in pumps handling aluminum chloride slurry, weak sulfuric acid and similar corrosive materials.



Service records of an Eastern petroleum refinery show that these centrifugal pump shafts made of Armco 17-4 PH® not only cost less to produce but provide much longer service than the material formerly used.

The reason is this new Armco precipitation-hardening stainless steel offers an unusual combination of high strength and hardness, excellent corrosion resistance and simple, low temperature heat treatment in fabrication. It assures trouble-free, long-time service life for valve stems and plugs, shafting, mixing screws and blades, pump gears and other vital parts of chemical processing equipment.

High Strength Plus Corrosion Resistance

With Armco 17-4 PH you get the advantages of extra high strength and hardness. Mechanical properties like these show why 17-4 PH parts can be made stronger, more resistant to galling and wear.

Typical Properties 17-4 PH Bar
(Hardened at 875 F for 1 hour)

Ultimate tensile strength, psi	**180-210,000**
0.2% Yield strength, psi	**165-200,000**
Elongation in 2", %	**8—17**
Hardness, Rockwell	**C40—45**

Service data and laboratory tests show that 17-4 PH resists corrosion better than any of the martensitic chromium types of stainless steels. In fact, under certain conditions its corrosion-resistance compares with Type 302.

Fabrication Easy, Economical

Armco 17-4 PH presents no problems in the shop. It can be readily welded and machined, forged or cast. And the short-time heat treatment at only 850-900 F eliminates the danger of scaling and distortion. Parts can be finish-machined, then hardened without affecting tolerances. If you make or buy equipment that can benefit from the advantages offered by Armco 17-4 PH Stainless Steel bar, wire or forging billets, fill out and mail the coupon for complete information.

ARMCO STEEL CORPORATION
1916 Curtis Street, Middletown, Ohio

Please send me information on Armco 17-4 PH Stainless Steel for:

Name_____

Company_____

Street_____

City_____ Zone____ State_____

ARMCO STEEL CORPORATION

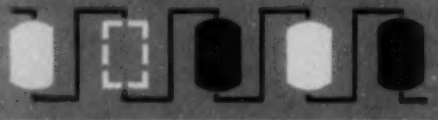
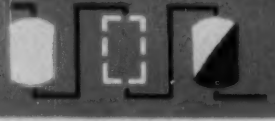
1916 CURTIS STREET, MIDDLETOWN, OHIO

SHEFFIELD STEEL DIVISION • ARMCO DRAINAGE & METAL PRODUCTS, INC. • THE ARMCO INTERNATIONAL CORPORATION

9 ways to demineralize water

(BY ION EXCHANGE)

KEY: Hydrogen Cation Unit — Removes metallic cations such as calcium, magnesium, sodium. Regenerated with sodium for simple water softening. Weakly Basic Anion Unit — Removes strongly ionized acids such as sulfuric, hydrochloric, nitric. Strongly Basic Anion Unit — Removes strongly ionized acids, also weakly ionized acids such as silicic and carbonic. Mixed Bed Unit — Contains both Hydrogen Cation and Strongly Basic Anion Exchangers, intimately mixed. Degasifier — Optional. Reduces load on Strongly Basic Anion Exchanger by removing free CO_2 brought in by raw water or developed in cation unit.

A	Effluent Conductivity—10 to 20 micromhos (no silica reduction)	Uses low-cost anion exchanger and anion regenerant (soda ash). Typical use—removing soluble salts from water for ceramic mixes and slips or from rinse waters used before painting, mirror silvering, etc.
B	Effluent Conductivity—same as A. Silica content—0.02 to 0.15 ppm.	Used for treating feedwater for boilers in general range of 600 to 1400 psi. Also (without degasifier) for removing impurities from plating baths and recovering chromate from plating rinses.
C	Same effluent as B.	For raw water with high sulfate and chloride content. Low-cost Weakly Basic Anion Exchanger removes major portion of electrolyte load. Countercurrent regeneration of anion units reduces operating costs.
D	Effluent Conductivity—2 to 5 micromhos. Silica same as B.	For same type of raw water as C. Countercurrent regeneration of both cation and anion units cuts operation costs.
E	Effluent Conductivity—1 to 5 micromhos. Silica same as B.	For waters where alkalinity is a major part of the anion content. Polishing units require infrequent regeneration. Produces, at low cost, low-solids feedwater suitable for high pressure boilers (over 1400 psi).
F	 Same effluent as E.	High flexibility of operation. Can operate in parallel for peak flows. Can maintain service flow during regeneration of either pair of units.
G	Effluent Conductivity—less than 1 micromho. Silica same as B.	Produces effluent of extremely high quality. Suitable for "super critical" pressure boilers and atomic reactors. (Initial and operating costs are usually higher than for separate anion and cation units.)
H	Same effluent as G.	For raw water with high sulfate and chloride content. Two-step demineralizer reduces load on Mixed Bed unit, cuts operating cost. (Strongly Basic Anion Exchanger is used in place of Weakly Basic where raw water has high silica and alkalinity.)
I	 Same effluent as G.	Recommended where alkalinity of raw water is high. Cation unit and Degasifier reduce load on Mixed Bed unit, cut operating costs.

All of the above systems, with equipment and resins made by Permutit, are in commercial use. Other combinations are possible—also use of special ion exchangers such as PERMUTIT SK for separating uranium oxide from other metallic oxides in ore.

Most of these systems (C and higher) are used almost exclusively for demineralizing feedwater for high-pressure boilers . . . but the list of possible applications in other fields is growing.

If you have a problem ion exchange might solve, we'll be glad to study it with you and bring you the benefits of this experience. Address: The Permutit Company, Dept. P-8, 330 West 42nd St., New York 36, N. Y.

PERMUTIT®

rhymes with "compute it"

ION EXCHANGE for Water Conditioning
Chemical Processing • Industrial Waste Treatment

INTRODUCING...

the first combined

GPC AND DDA

GENERAL PURPOSE DIGITAL COMPUTER AND DIGITAL DIFFERENTIAL ANALYZER

+−×÷>√Σ+−×÷>

+−×÷>√Σ

ultimate versatility in solving complex technical problems...

The general purpose digital computer solves most scientific and engineering problems with speed and accuracy... yet easier programming makes the digital differential analyzer a superior choice for solving differential equations. Bendix now combines the advantages of both in the *new* G-15D Computer and its optional DDA accessory. Working together, and supported by a full complement of input-output equipment, these units provide the *best* means of solution. And the rental or purchase cost is far below that of most general purpose computers alone.

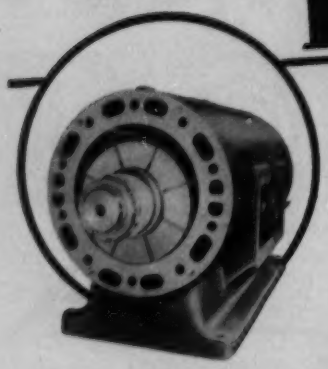
A new brochure tells the details of the G-15D's talent for conserving your scarce engineering manhours. Let us send you a copy.

Bendix Computer

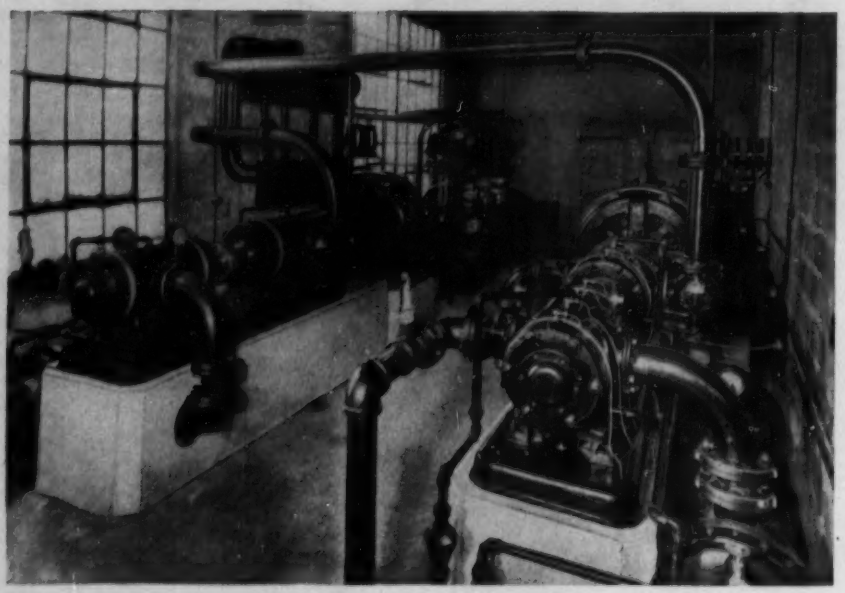
DIVISION OF BENDIX AVIATION CORPORATION

5630 ARBOR VITAE STREET, LOS ANGELES 45, CALIFORNIA

Fuller pioneered



the two-stage rotary compressor . . . for general industrial use . . . starting in 1930



INSTALLED 1930
STILL GOING STRONG

Two Fuller Rotary Two-stage Compressors. Capacity each 740 c.f.m., 100-lb. pressure.

Fuller Company not only pioneered the rotary compressor for industrial use in this country, but it has always stressed the "spotting" of compressors. There's nothing new or startling about this principle . . . Fuller has advocated it ever since its first machines were put on the market in 1930 . . . applying each compressor to a specific job, with resultant overall plant economy, as well as power savings. Result: the adoption of this economical layout by thousands of users has proved to their satisfaction the soundness of such a program.

Fuller has built and sold thousands of Fuller Rotaries—a large proportion of the two-stage type. And, when plant expansion is necessary, with a consequent demand for more air, additional Fullers are naturally installed.

Fuller engineers have never rested on their oars, but have continually worked to improve design and efficiency, until today, these machines are second to none for dependable air-production in industry.

We welcome the opportunity to present to you all the facts concerning Fuller Rotary Compressors, facts built on actual operational experience. For a complete description of Fuller Rotaries, write for Bulletin C-5A.

FULLER COMPANY, 124 Bridge St., Catasauqua, Penna.
GENERAL AMERICAN TRANSPORTATION CORPORATION SUBSIDIARY
Chicago • San Francisco • Los Angeles • Seattle • Birmingham

C-275
1783

Fuller

PIONEERS OF HIGH-EFFICIENCY VANE TYPE ROTARY COMPRESSORS SINCE 1930

This plant handles chlorinated hydrocarbons

Its proved answer to corrosion will work for you, too... with almost any corrosive you can name

Are the corrosives you use as vicious in their attack on pipelines as hot chlorinated hydrocarbons? Or strong water HCl dilutions?

These chemicals cost the Thiokol Corporation large amounts of money at their Moss Point, Miss., plant when it was started. The corrosion rate was high. Pipeline replacement was frequent. In short, there were serious corrosion problems.

After testing many kinds of pipe, Thiokol installed PYREX brand glass pipe, which tests proved most economical.

Maintenance costs reduced

After four years of steady service, these lines look and operate like new. They are free of corrosion and erosion.

Cost figures over the four-year period still indicate that PYREX pipe is the most economical installation for this exposure. At Thiokol, maintenance is very simple and cost is reasonable.

Thiokol Corp. avoids cleaning trouble

In this process, paraformaldehyde occasionally builds up. This could be a real threat in any opaque pipe but it's visible in glass. As soon as it collects, Thiokol flushes it out with steam.

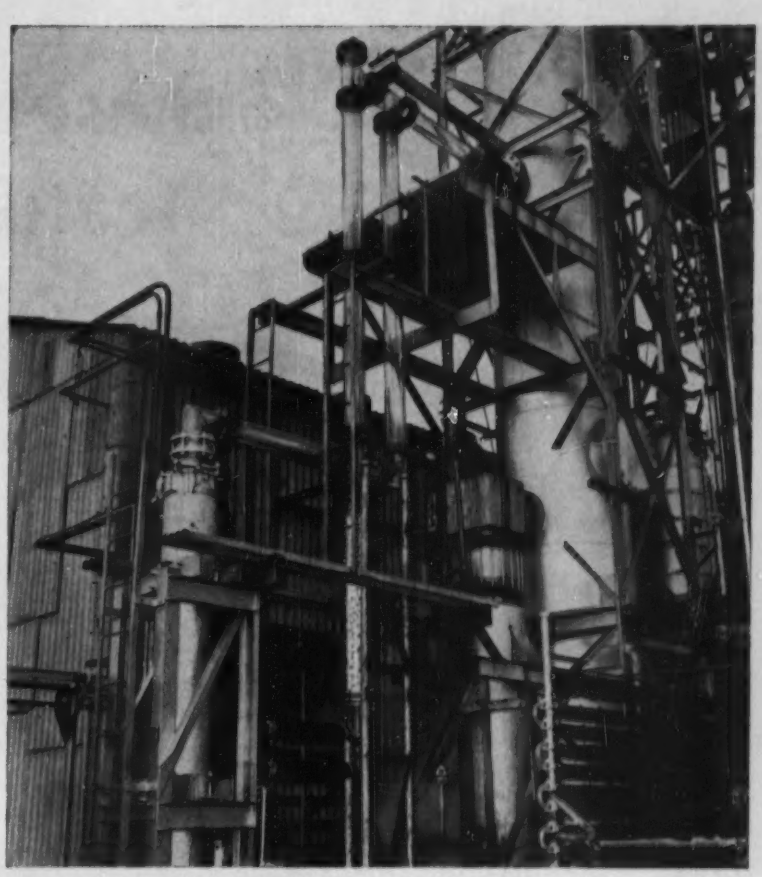
Easy cleaning is a prime characteristic of PYREX pipe. Suppose you want to use the same lines for incompatible fluids. You clean glass lines at change-over time simply by flushing them with low pressure steam, hot water, detergent solution, or, in some cases, with dilute HCl. No down time, no difficulties. And you *see* when lines are clean.

Easy, low-cost installation

The men who regularly install your piping can install glass pipe easily, even if they've never worked with it before. Thiokol's own men cut and assemble PYREX brand pipe. The field kit makes this an easy job.

Your corrosion problem

No matter what corrosives you transport, except HF and hot concentrated alkalis, PYREX brand glass pipe stops the corrosion problem.



Four years of hot chlorinated hydrocarbons and strong solutions of HCl and water and pump vibration . . . yet these glass lines operate today as well as they did when new.

One of the best ways to really know the advantages of glass pipe is through knowing a user. To meet one near you, write us and we'll try to set up a visit. In the meantime, we can send you informative literature. Send the coupon.

Corning means research in Glass

CORNING GLASS WORKS, 18 Crystal Street, Corning, N. Y.

Gentlemen:
I would like to see an installation of PYREX pipe. Please contact me to make arrangements ☐.

My corrosion problems involve these chemicals.....

.....

Please send the following literature: Bulletin EA-1, "PYREX Pipe in the Process Industries" ☐; Bulletin EA-3, "PYREX brand 'Double-Tough' Glass Pipe and Fittings Catalog" ☐; Bulletin PE-3, "Installation Manual for PYREX Pipe" ☐.

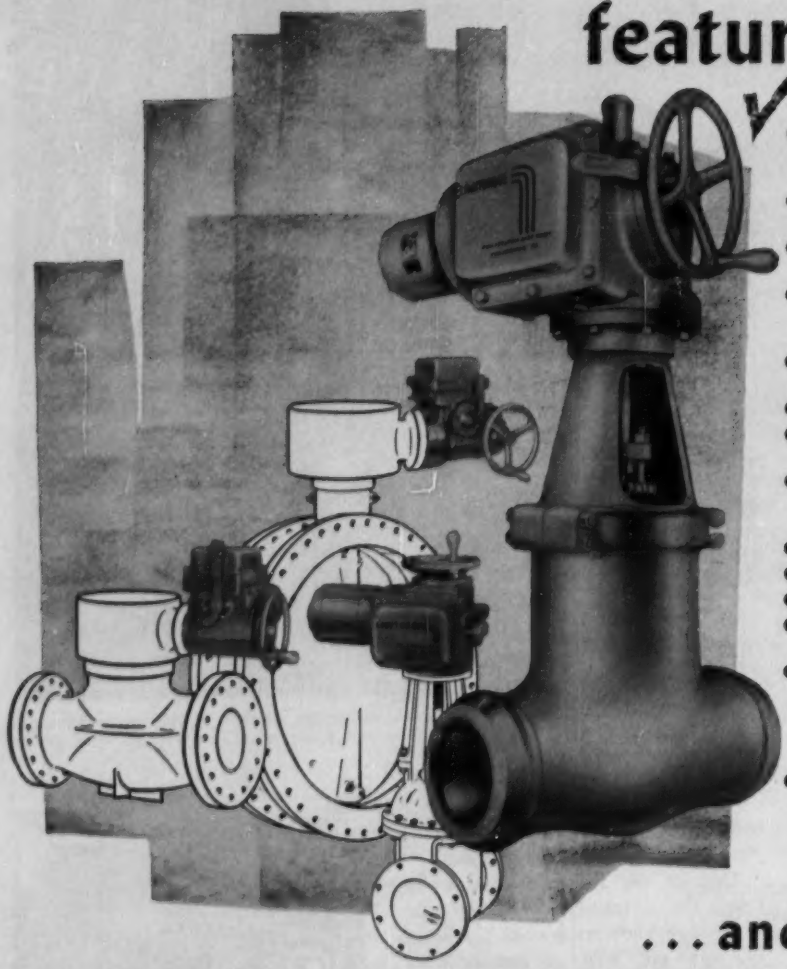
Name.....Title.....

Company.....

Street.....

City.....Zone.....State.....

Check these features



- Micrometer torque seating switch gives tight valve closure, and protects valve parts from damage.
- Self contained unit—no gears, stem nut or bearings to buy.
- Weatherproof, dust-tight and water-tight construction.
- Hammerblow device . . allows motor to reach full speed, before load is engaged.
- Non-rotating handwheel built into the unit.
- Automatic declutching.
- Motor is disengaged during handwheel operation.
- Can always be declutched for handwheel operation regardless of weather or electrical conditions.
- High torque motors.
- Simple valve yoke.
- May be mounted in any position.
- Three to four times faster handwheel operation.
- Actuation may be by any available power source such as electricity, air, oil, gas, water or steam. LimiTorque is readily adapted for microwave control.
- LimiTorque is designed for plug, butterfly, gate and globe valves up to 96" diameter . . . Entire Unit and nut can be lifted off valve yoke, by removing flange bolts.

. . . and you'll understand why more *LIMITORQUE* valve controls are in use than all others combined

Send for new catalog L-550, and please use your Business Letterhead when requesting.

LimiTorque®

Be sure and see our Exhibit at Booth 1816, 11th Annual Instrument Automation Conference and Exhibit (International), Coliseum, New York City, September 17-21, 1956.

PHILADELPHIA GEAR WORKS, INC.
ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.
Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID AGITATORS • FLEXIBLE COUPLINGS

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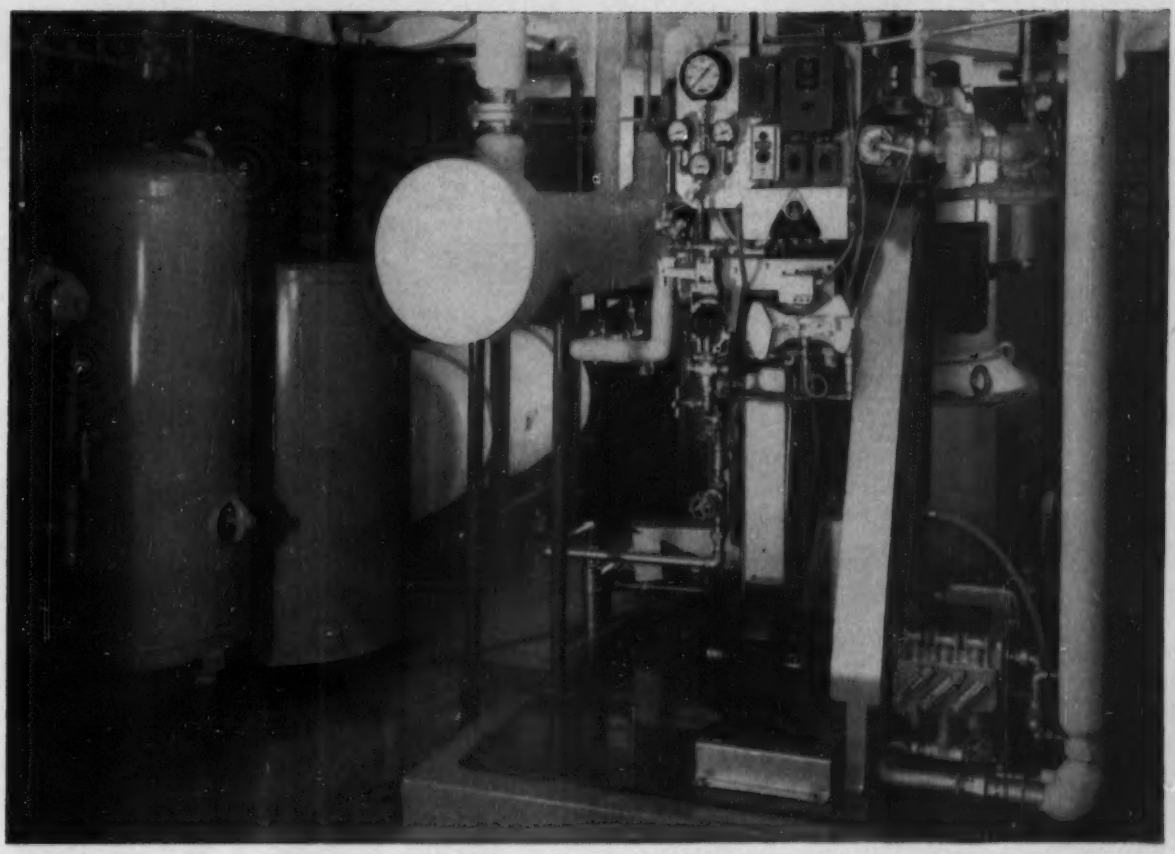


100 b.h.p. Modulātic at Foam Food Products, Los Angeles. Floor area, only 5' x 7'-3". Floor load, just 150 lbs./sq. ft.

Beautiful!.. in appearance, performance

MODULĀTIC STEAM GENERATOR

— world's most compact power-package

This good-looking Modulātic installation shows how clean and uncluttered, how efficiently functional *your* steam generator space can be.

"Boilerhouse?" No! Modulātic needs no expensive enclosure, foundation, stack—takes no more room than a desk and chair. Any aisle or unused corner *anywhere* —basement, balcony, roof—is all the space you need.

Shipped fully assembled—just connect and fire up . . . equally easy to move. Passes through plant-type doorways. Can't waste fuel or water because steam is made only "on demand" to maintain the pressure you want.

As your main steam source or added capacity for power, processing, heating . . . for emergency service or conventional purposes . . . for permanent installation or mobility . . . there's nothing like Modulātic. Proved by more than 10,000 (now 13,000) in use.

Full steam in two minutes from cold starts ends early reporting and standby. Quiet, pushbutton operation. Eight sizes: 10 to 160 b.h.p. Pressures from 5 to 285 p.s.i., and *much more.* Oil, gas, or combination burner. Single or multiple units. *In Canada, write Vapor Car Heating Co. of Canada, Ltd., 65 Dalhousie Street, Montreal 3, Que.*

50 years of steam generation and controls

VAPOR HEATING CORPORATION
80 E. Jackson Blvd., Chicago 4, Ill., Dept. D-8.

Please send me free 12-page Modulātic Booklet No. 586. I use steam for_____

Name_____

Company_____

City_____ Zone_____ State_____

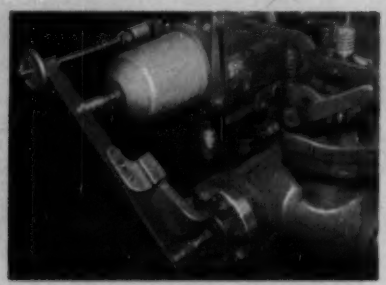
You're ahead 6 ways...

with the ELLIOTT YR TURBINE

The simplicity and adaptability of the Elliott YR Turbine give it advantages that put it well ahead for pump, fan, compressor and other machine applications. These features all add up to the kind of long-term dependability that makes Elliott the preferred choice among plant engineers everywhere. Bulletin H-22A gives complete details. Write to nearest district office or to Elliott Company, Jeannette, Pa. for your copy.

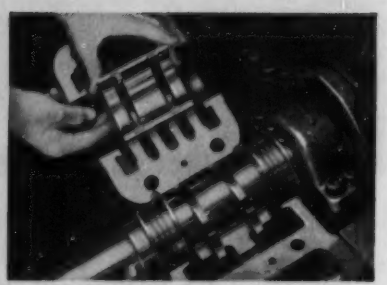
True Centerline Support

Assures alignment cold or hot and simplifies installation. Note how the sturdy exhaust-end pedestal is separated from the hot turbine casing.



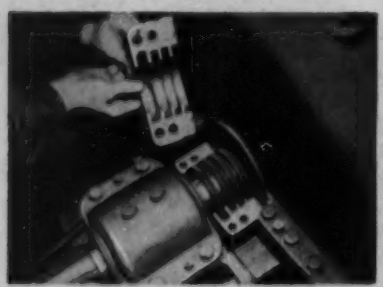
Simple, Reliable Governing System

Weather-proofed standard governor, with fly-ball type speed-sensitive element, mounted directly on the turbine shaft, is the simplest, most rugged, and reliable type of governing.



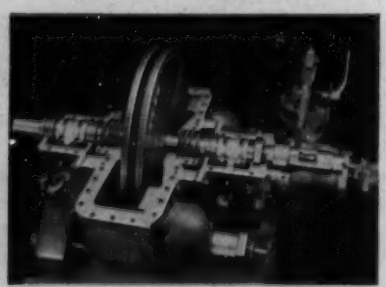
Liner Type Bearings

Bearing cap is easily removable so that the inexpensive liner type bearing can be readily inspected or replaced. Labyrinth seals effectively protect the bearings against the elements.



Accessible Shaft Seals

You don't have to raise the upper half of any YR turbine casing to get at the shaft seal for inspection or ring replacement. Just remove a few bolts and the steam-tight packing gland cover comes off.



Self-Locating Rotor

Permanently fixed locating bearing makes it possible to drop the turbine rotor into perfect position without requiring adjustments.

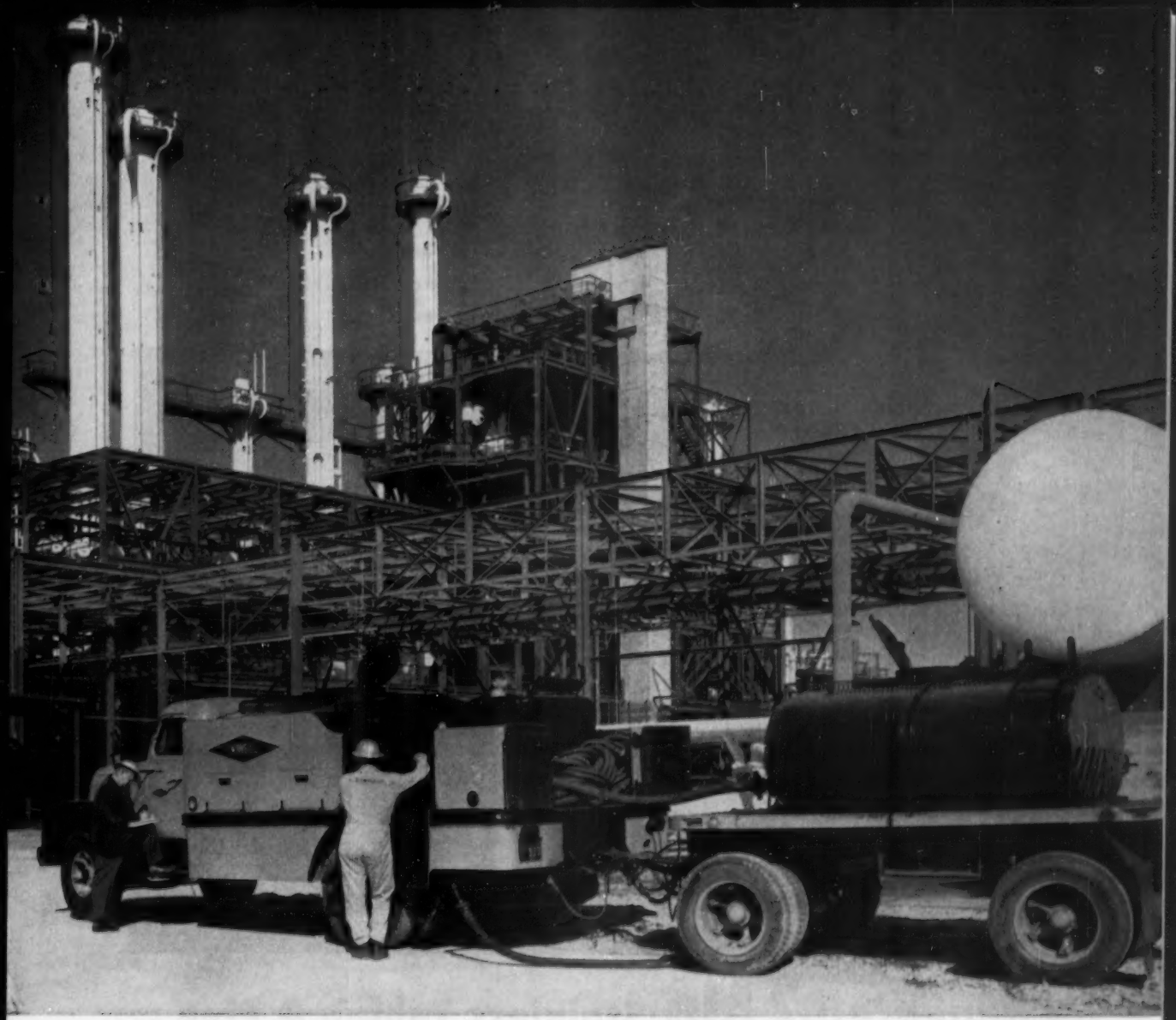
Interchangeable Components

Renewal parts inventories are reduced by the interchangeability of wearing parts between turbine frame sizes. Possible modifications make turbines suitable for special requirements while retaining parts interchangeability.

ELLIOTT Company

H5-1

TURBINE-GENERATORS TURBINES MOTORS GENERATORS DEAERATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS



IT'S NOT WORTH THE CHANCE —CLEAN IT RIGHT

Equipment that operates at less than peak efficiency eats into your company profits. Chemical cleaning can help stop these losses—but only when it's done by experts. Unless you rely on experts, you're taking a chance with your men and valuable equipment.

Dowell engineers understand your cleaning problems and they have the *experience* needed to solve them. Thoroughly trained, they're backed by Dowell's 15 years' experience in removing troublesome scale deposits from virtually every kind of equipment in every kind of industry. They're aided, too, by a completely modern, fully staffed and excellently equipped *research* laboratory.

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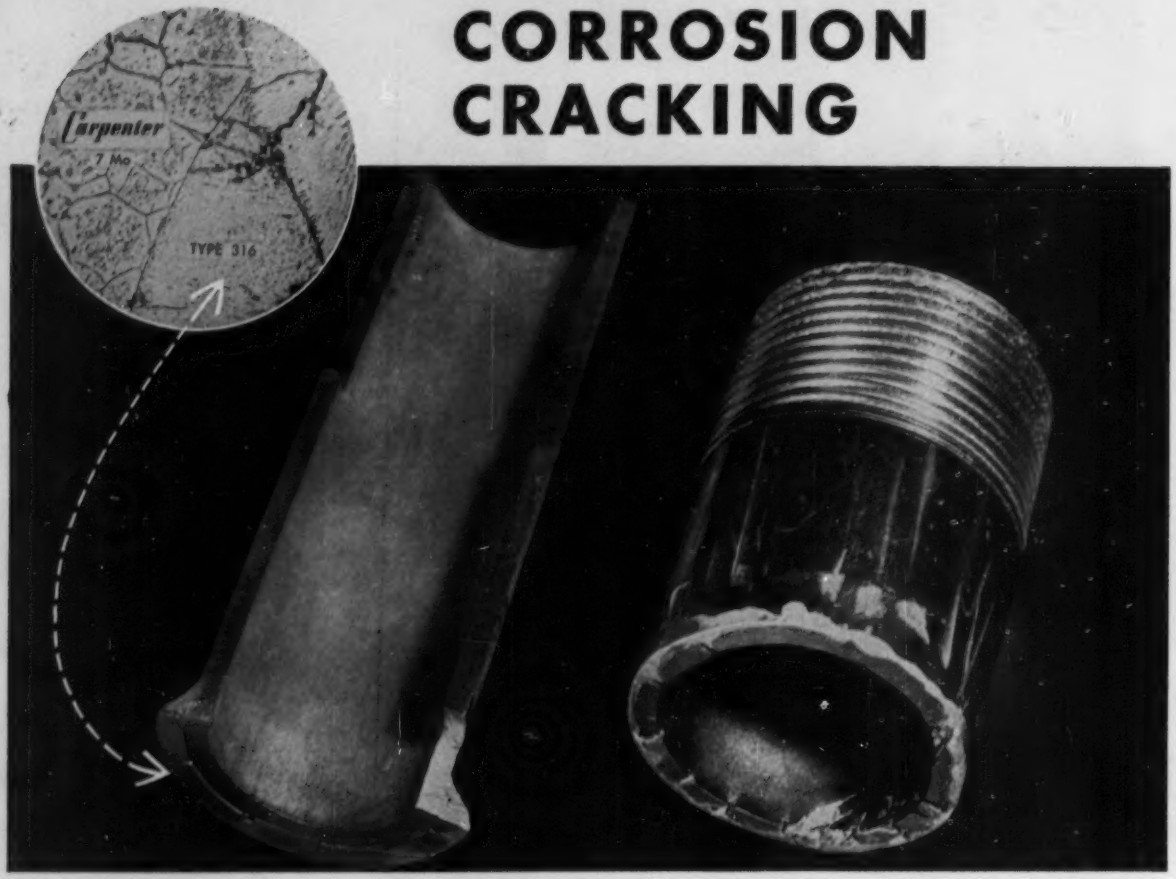


Carpenter 7 Mo Stainless Tubing & Pipe

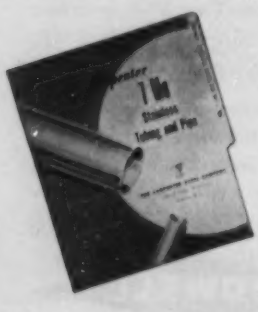
Take a closer look at the above section of Carpenter 7Mo Stainless Pipe welded to a Type 316 fitting. See how stress corrosion cracking has ruined the fitting, just as it has destroyed the piece of stainless pipe at right.

Note how the cracks in the fitting stop abruptly when they reach the 7Mo pipe. And this pipe has already outlasted three such fittings. The photomicrograph shows the unmistakable proof.

If you have conditions where chlorides, caustic or sulphite solutions are present, Carpenter 7Mo's excellent resistance to general corrosion, pitting and stress corrosion cracking may prove to be a real cost-saver. Let's discuss your particular application now.

The Carpenter Steel Company
Alloy Tube Division, Union, N. J.

Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"



Write for this Carpenter 7Mo Technical Bulletin.

Carpenter
Stainless Tubing & Pipe

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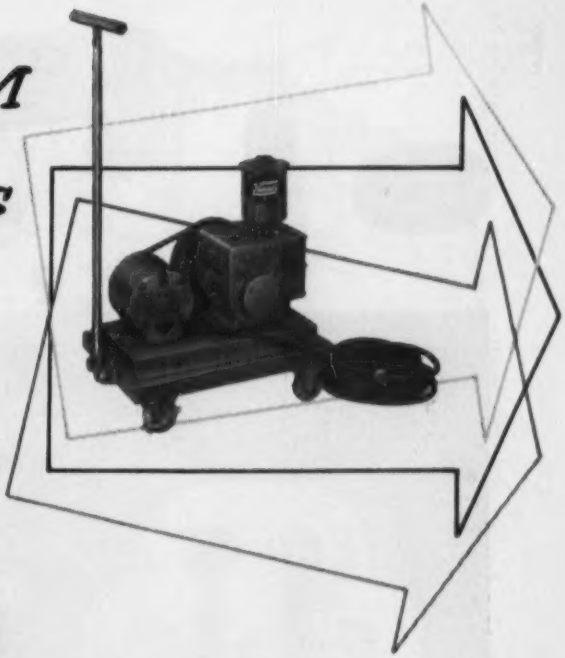
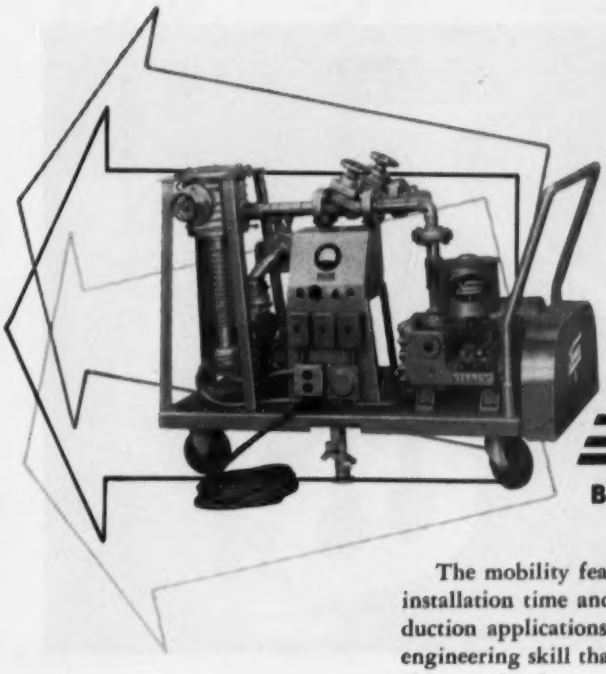
...to suit all needs





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The mobility feature basic in the design of these units cuts down on installation time and materials . . . in experimental, pilot plant, or production applications . . . for added efficiency and flexibility. The same engineering skill that has made Kinney pumps synonymous with dependable, trouble-free service went into the design of these units . . . to give you the highest volumetric efficiency and highest dollar return per CFM available.

LARGE UNIT components include: a Kinney KC-15 roughing and backing pump, a 4" fractionating diffusion pump with 4" baffle valve, and a Kinney KC-2 holding pump . . . mounted on fabricated base having tubular handle, swivel casters, and caster lock. A 3 station thermocouple gauge (Ion gauge-TC gauge instrumentation optional) and a central control panel are also included. Only utility requirements are cooling water for diffusion pump and single phase 110 volt power supply (extra long service cord supplied with unit).

SMALL UNIT components include: A Kinney KC-5 air cooled pump capable of providing an ultimate pressure of 0.2 Micron-McLeod Gauge, a ½ HP motor complete with cord and plug . . . all mounted on a compact, fabricated dolly with tubular handle, swivel casters, and caster brakes. Complete unit weighs only 170 pounds and measures 22½" long, 14" wide, and 22½" high. Handle in upright position measures 36" from floor. Request complete data.

Kinney offers the world's largest line of vacuum equipment. Let our engineers send you recommendations on your particular problem. Request Bulletin V54 describing the complete line of Kinney Vacuum Pumps or contact one of our competently staffed offices . . . in Baltimore, Charleston, W. Va., Charlotte, Chicago (La Grange), Cleveland, Detroit, Houston, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, San Francisco, St. Louis, and The International Sales Office, 90 West St., New York 6, N. Y.

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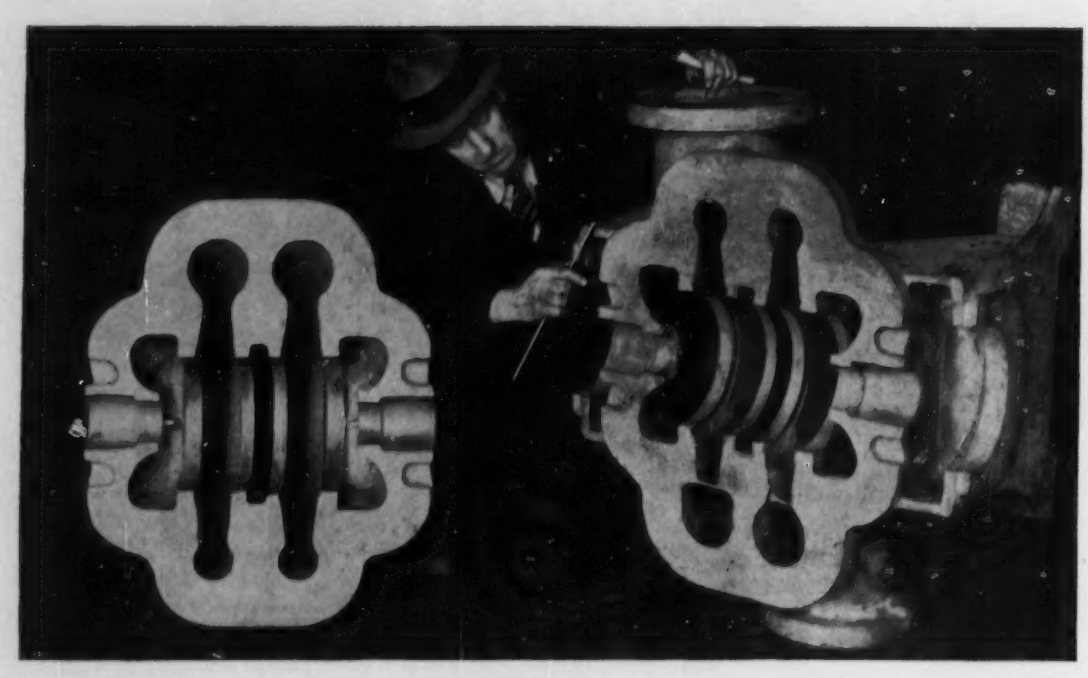

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32 pages of valuable and complete data on stainless castings: analyses, properties, technical data on handling and heat treatment, typical applications, how to order, etc.

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For your assurance, there's a long record of years of successfully answering difficult service conditions with sound, clean-grained AL Stainless Steel castings—free from defects, easy to machine and dependable in supply. ● Let us quote on *your* stainless casting requirements. *Allegheny Ludlum Steel Corporation, Henry W. Oliver Building, Pittsburgh 22, Pennsylvania.*

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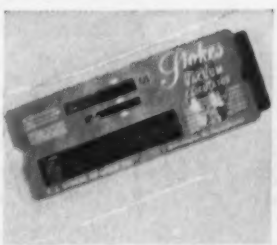
Ideal for pilot plant or production processes, Microvac pumps are designed for exceptionally low maintenance. Oil leakage at the shaft is eliminated by a unique mechanical face seal. There are no stuffing boxes. Lubrication is fully automatic. Intake screen filter keeps out dirt and scale. Oil line filter protects bearings and shaft seal.

Over their entire pressure range, Microvac pumps give high efficiency . . . are widely used by themselves or as roughing pumps with booster or diffusion pumps. Call the nearest Stokes office for a consultation on your specific vacuum application.



Stokes Vacuum Calculator contains valuable high vacuum data, simplifies calculation of pump performance and selection of pump size for specific applications. Get your free Calculator, by writing to Stokes today.

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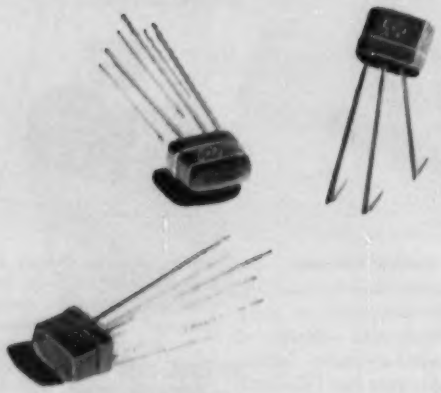

Not too long ago this relatively rare metal was a laboratory curiosity. What to do with it? Today, it's the heart of the tiny transistor—the latest giant of electronics!

What's the connection between Sulphur and Germanium?

There are two, in fact. One is man-made, involving the routine leaching of Germanium ores with Sulphuric Acid prior to tetrachloride distillation. The other takes advantage of a peculiar property of the natural mineral, Germanium Sulphide. This mineral can be volatilized and then sublimed, providing an effective method of separating the Germanium from gangue material. The process is called "Concentration of Germanium by Sulphide Sublimation".

Again Sulphur, through its major derivative, Sulphuric Acid, and a natural sulphide play an important role in our ever-expanding economy. It is difficult to find many items in the broad chemical-metallurgical field that do not somewhere along the production line make use of Sulphur or a derivative.

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But regardless of what traps you use at the present time, we'll be glad to help you with any problem you may run into in getting your equipment in shape.

Write, today, for your copy of new Bulletin 10-55—for detailed information.

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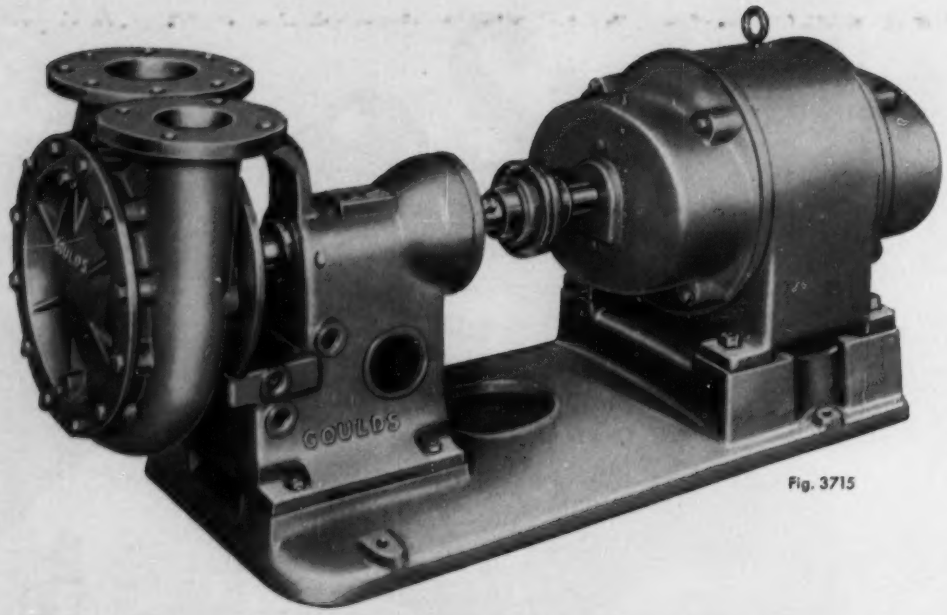


Fig. 3715

Here's a pump especially designed for your **ABRASIVE** and **CORROSIVE** liquids

You minimize your "hot" pumping problems — and expenses — with Goulds chemical pumps because *they're built to take it!*

With the Fig. 3715 pump, you can handle liquids that would "murder" most pumps. Such liquids as acid, alkaline liquor, hot size, and slurry. But this pump offers more than just severe service design. You get fewer maintenance problems plus special operating advantages.

Look at the support head—its rugged, box-type design with water jacket permits you to pump liquids as hot as 350° F. Over-lubrication is prevented by grease-lubricated standard bearings with grease relief. You can adjust impeller clearance without any dismantling by means of a simple, positive external arrangement.

A variety of construction materials meets every need. Goulds Fig. 3715 pumps come in Type 316 and Gould-A-Loy 20 stainless steel, all aluminum-bronze, all iron or bronze-fitted.

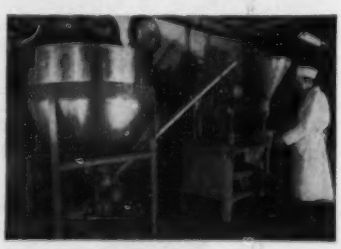
There's a wide range of sizes, too —nine in all—with capacities up to 720 GPM and heads to 200 feet. You can keep a low spare parts inventory since many of the parts are standardized for interchangeability between sizes.

There are many more reasons why you can save money and avoid maintenance headaches by pumping those harsh liquids with a Goulds Fig. 3715 pump. Learn about them by addressing your inquiry to Goulds Pumps, Inc., Seneca Falls, N. Y.

Ask for Bulletin 725.4.

Here is a Goulds pump handling hot fatty acids in an oil processing plant.

Here are three Goulds chemical pumps circulating hot size in a textile plant.



Goulds stainless steel pump handles corn meal mush in a food plant.

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Seneca Falls New York

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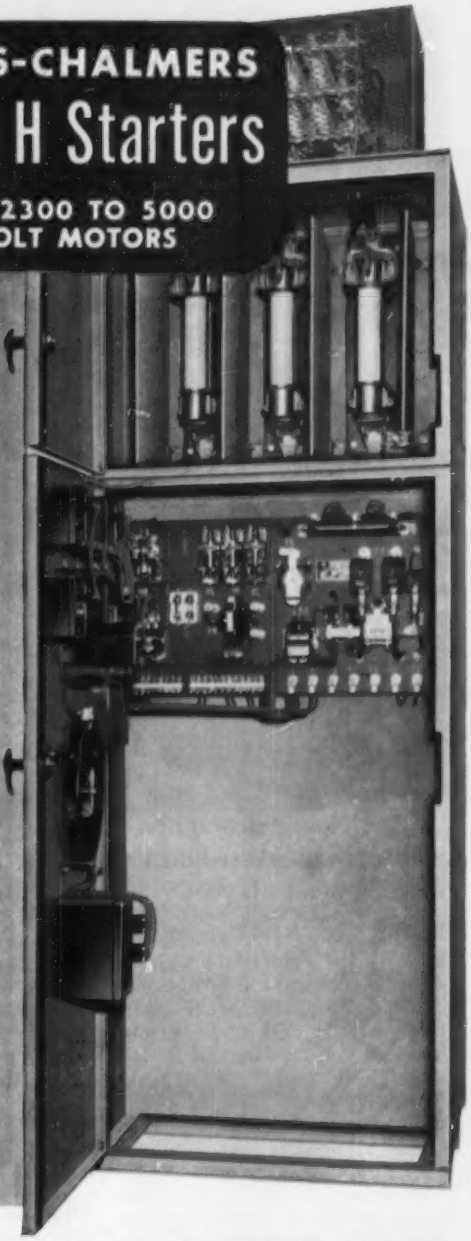
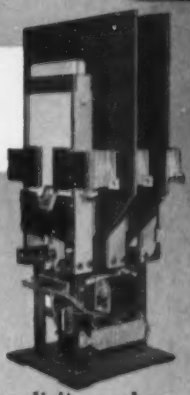
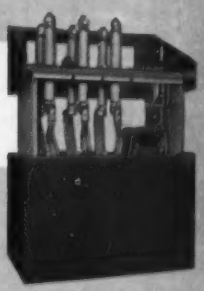




AIR

Designed for top performance on the rough-tough jobs. Advantage of contacts operating in air include long contact life, reduced fire hazard, easy maintenance. Double-break contacts, vertical action and dual blowouts provide long, dependable operation. Design simplicity makes contactor particularly adaptable for applications requiring frequent starting, inching, reversing, or dynamic braking.



OIL

Meets operating demands of semi-hazardous locations. Contactor operates under oil to prevent sparks from igniting atmosphere and to protect mechanism from corrosion. Contactor is time-proved clapper type. Self-cleaning, rolling-wiping action extends contact life. Self-aligning E-type magnet provides perfect armature seating . . . quiet, maintenance-free operation.

YOU GET MORE...

Allis-Chalmers offers help on specific control application problems. Call your Allis-Chalmers representative. His recommendations are backed by Allis-Chalmers engineering departments . . . by the experience gained in solving thousands of control problems . . . by complete research and testing facilities.

For complete information on the Type H starter, write for Bulletin 14B6410B — Allis-Chalmers, General Products Div., Milwaukee 1, Wis.

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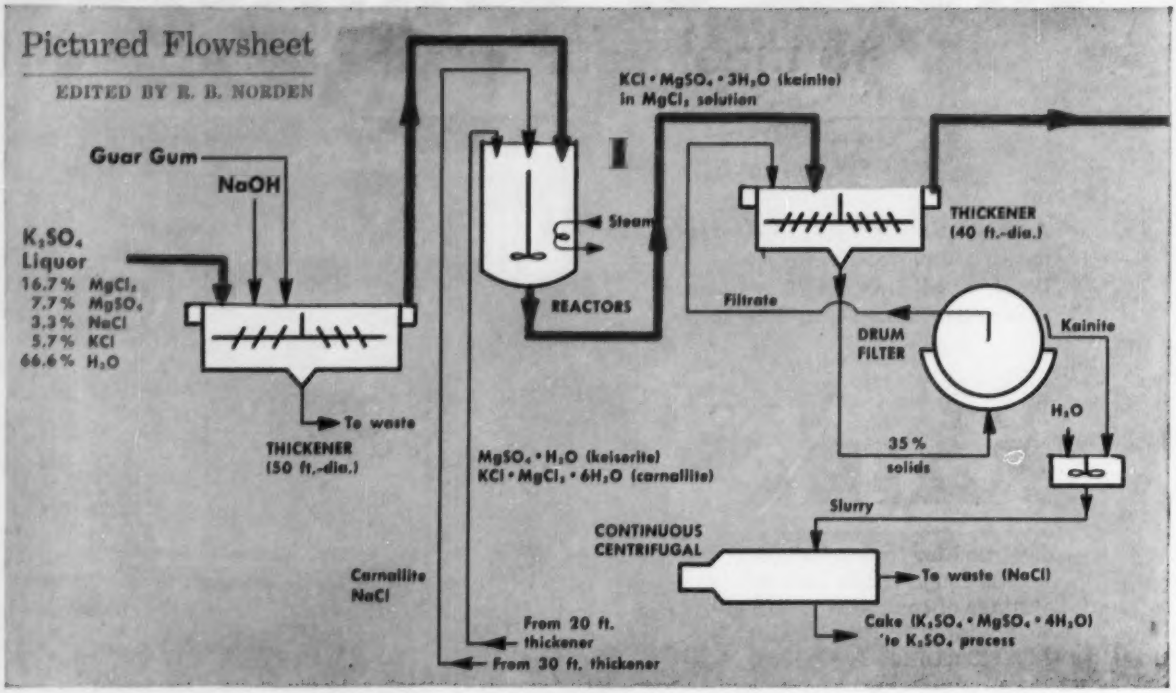


New Process Converts $MgCl_2$ into MgO, HCl

Going through its paces in a new $3.5 million plant, process based on waste brine makes available commercial amounts of 99.5% MgO for first time in U. S.

With laboratory, pilot plant and full scale start-up programs out of the way, International Minerals and Chemical Corp. now reveals details of a new process for making HCl and magnesium oxide.

Long eyeing potentially big markets (see p. 142) IMC has been vigorously working on economical methods for converting waste $MgCl_2$ brine into pure grades of MgO (fused refractories and electrical insulators, chemical treatments) and commercial grade HCl (acidizing oil wells).

▶ **Why Waste Brine?**—Five potash producers including IMC at Carlsbad, N. M., mine and process sylvinite (KCl-NaCl) ore and make potassium chloride fertilizers.

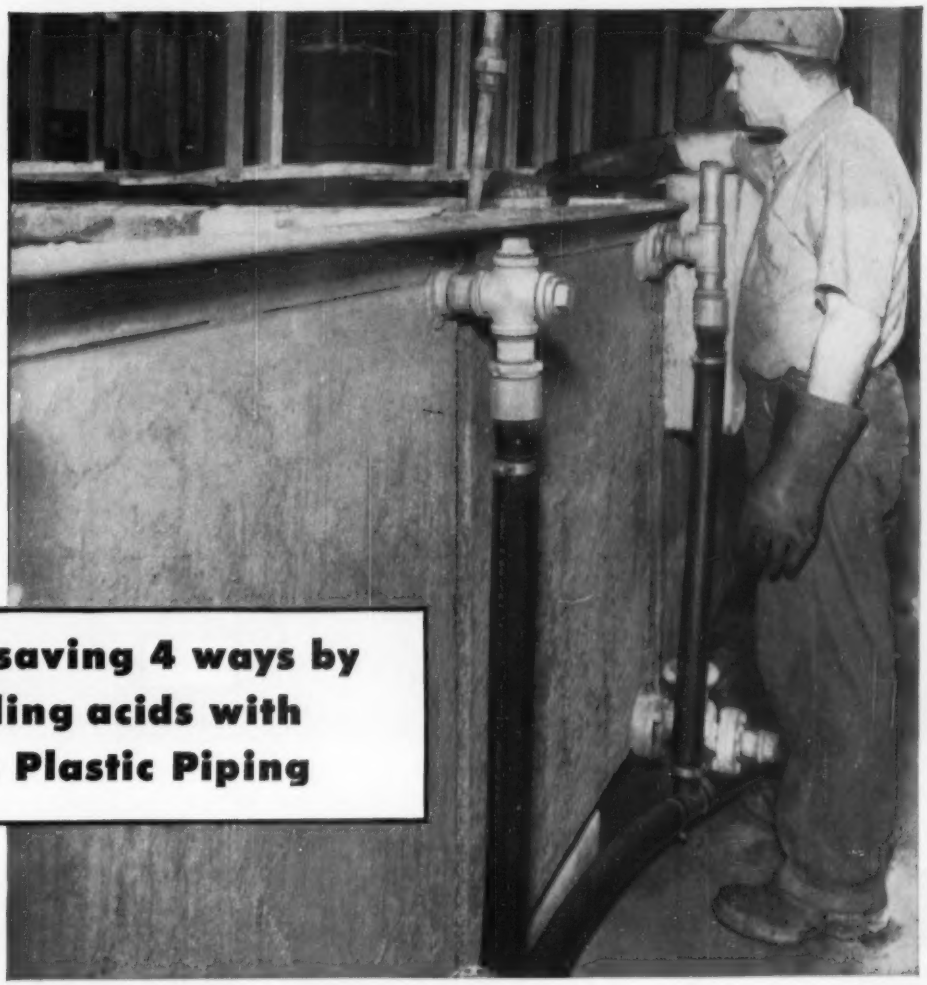
But at Carlsbad IMC also makes potassium sulfate from the only known U. S. commercial deposit of langbeinite—a double salt of potassium and magnesium sulfate. Actually this ore is first refined physically. Part is sold as fertilizer, and part reacted with a KCl solution forming K_2SO_4 fertilizer and an impure $MgCl_2$ solution.

In a $3.5 million plant at Carlsbad, IMC concentrates and purifies this $MgCl_2$, removing alkali salts; then converts the chloride in two steps (1,000 F. and 3,000 F.) forming HCl vapor and 10,000 tons/yr. of 99.5% MgO. This is the first time in U. S. that high-purity MgO has been produced in such large quantities. The vapor is absorbed in a battery of five packed columns forming 54,000 tons/yr. of 31.5% HCl.

▶ **Clearing and Reacting** — A tricky combination of thickeners, crystallizers and kilns, the process first calls for purification of the waste liquor containing $MgCl_2$, $MgSO_4$, KCl and NaCl (*see flowsheet*). The clay formed is flocculated and separated from the brine in a thickener—underflow goes to waste.

Clarified liquor reacts continuously at 65C. in steam heated tanks with a recycle slurry containing concentrated magnesium chloride, solid KCl•$MgCl_2$•$6H_2O$ (carnallite), sodium chloride and $MgSO_4$•H_2O (kieserite). Carnallite breaks down to form KCl crystals and soluble $MgCl_2$. The KCl then reacts with $MgSO_4$ to form the salt KCl•$MgSO_4$•$3H_2O$ (kainite).

▶ **Purifying $MgCl_2$** — After six hours reaction time, the slurry (kainite-sodium chloride in a magnesium chloride solution) goes to a thickener. Underflow (35% solids) is filtered on a drum filter—filtrate goes back to the thickener. The cake (kainite-NaCl) is slurried with water at 42C. for one hour. A reaction takes place forming K_2SO_4•$MgSO_4$•$4H_2O$ crystals, while the NaCl dissolves. The sodium chloride solution is discarded and the crystals sent back to the potas-



They're saving 4 ways by handling acids with Crane Plastic Piping

THE CASE HISTORY— Globe-Union Inc., leading storage battery builder, in its Milwaukee plant, might have decided plastic piping wasn't for them and let it go at that. Instead, they gave Crane plastic products a fair trial, and here are the results.

On hydrochloric acid lines to zinc-plating tanks, the metal pipe and fittings formerly used had to be replaced completely about every month. Corrosion was the cause.

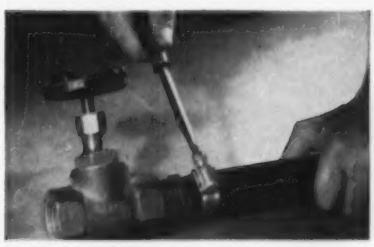
With Crane polyethylene pipe and Crane plastic fittings in this same service, after more than 3 months there is no sign of deterioration and no apparent need of early replacement.

On battery test tanks, Crane plastic piping, exposed to built-up sulphuric acid concentration, looks good as new after more than 4 months' service.

Savings with Crane plastic piping are adding up 4 ways. Plastic cancels the need for costlier metal pipe. It is installed in a fraction of the time it takes for metal pipe and fittings. It reduces installation to a one-man job with simple hand tools. The longer life of plastic is saving replacement, maintenance and housekeeping costs.

Proved in severest services, Crane plastic piping is giving Globe-Union equal satisfaction on many low-pressure air and water lines. Here freedom from sweating is another advantage of plastic.

Once you know the facts of quality-designed, quality-made Crane polyethylene pipe and Crane plastic insert fittings, you, too, will see many opportunities for saving with this modern piping. Call your local Crane Representative today, or write to address below.



Crane adapter makes plastic-to-metal joints easy

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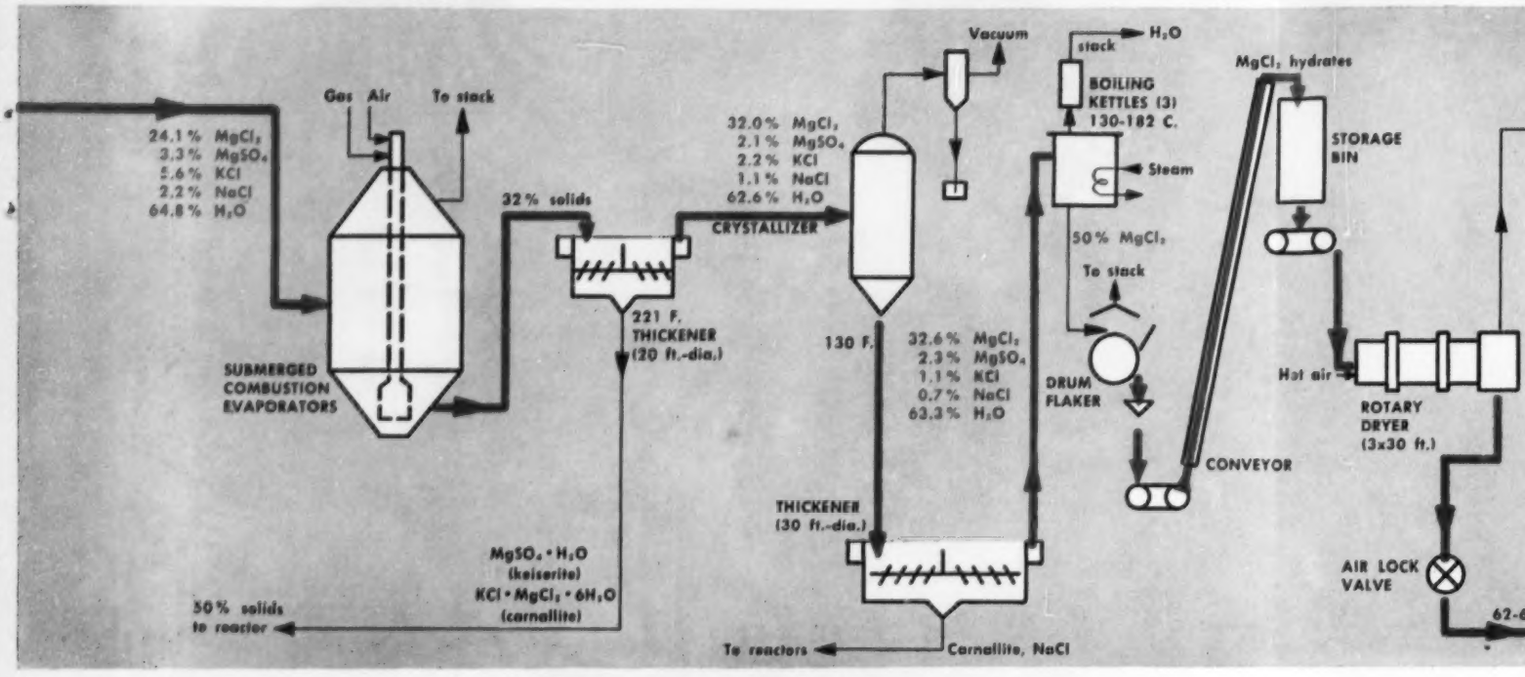


sium sulfate process, after separation on a centrifugal.

Overflow mother liquor from the thickener contains about 24% $MgCl_2$, 64.8% H_2O and 11.2% impurities ($MgSO_4$, KCl, NaCl). These impurities are removed by taking advantage of solubility relationships.

▶ **Concentrating $MgCl_2$** — Gas-fired submerged combustion evaporators are used to increase $MgCl_2$ concentration to 32%. The evaporated slurry is thickened (105C.) in an insulated thickener. Underflow contains various salts ($MgSO_4 \cdot H_2O$, NaCl, $KCl \cdot MgCl_2 \cdot 6H_2O$), and is sent back to the reaction tanks.

Clear liquor, neutralized with NaOH, is then cooled to 55 C. in an adiabatic flash crystallizer. Sodium and potassium chlorides crystallize and are separated in a thickener. Underflow recycles to the reaction tanks. Clarified overflow liquor has 32.6% $MgCl_2$, 2.3% $MgSO_4$, 1.1% KCl, 0.7% NaCl, 63.3% H_2O. This is further concentrated to 49.5% $MgCl_2$ in three steel steam heated boiling tanks lined with acid-proof brick and cement.

Concentrated brine then flows to a series of three water-cooled steel flaking drums. Cooled flakes are made up of a mixture of hexahydrate and tetrahydrate magnesium chloride. These feed into a Roto-Louvre dryer.

▶ **Converting to MgO** — Dry flakes (62-64% $MgCl_2$) go to the rotary decomposition kiln. Decomposition of $MgCl_2$ hydrate is complete here at a discharge temperature of 1,000 F. Heat comes in through a 6-in. gas burner at the feed end of the kiln (2,200 Btu./lb. feed).

The combined decomposition and combustion gases (13% by vol. HCl, 22-24% H_2O) leave the discharge end at 1,300 F., then pass through a steel duct to the HCl unit.

Product from the decomposition kiln: 80% MgO, 12% $MgSO_4$, 2.5% NaCl, 2.5% KCl and 0 to 2.5% $MgCl_2$. It discharges into a water-cooled drag conveyor with stainless steel troughs, then to storage bins fitted with feeding mechanisms for adding reagents or sintering compounds.

Actual mixing takes place in a screw conveyor which passes the material into a double roll pelletizer. Pellets are screened before entering the high-temperature kiln.

▶ **High Temperature Kiln**—In a 165-ft. rotary kiln the remaining alkali chlorides volatilize, and $MgSO_4$ decomposes—producing a 99.5% MgO. The kiln is lined with periclase (MgO) brick at the feed and discharge sections. It rotates at 40 rph., has two burners for combustion of 350-400 cfm. natural gas. Temperature in product zone is 2,900-3,000 F. Combustion gases leave at 1,400 F.; cooled to 650 F. with air, they exhaust through a stainless fan and steel stack.

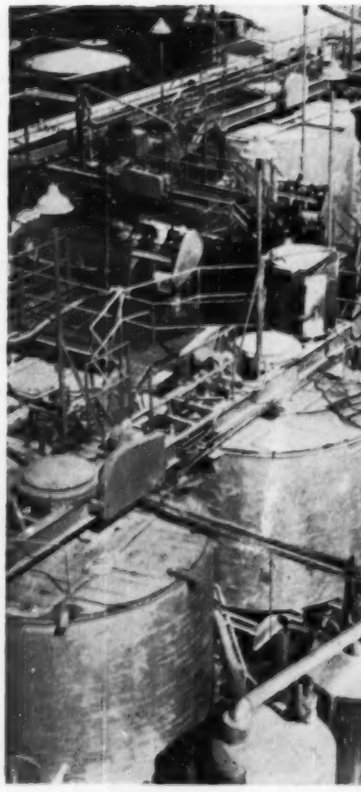
Product (pellets) discharges into a rotary cooler lined with 6-in. periclase brick.

▶ **Making Hydrochloric Acid**—Flue gas (13% by vol. HCl) is cooled in the first packed tower from 1,250 F. to 188 F. with recycle acid.

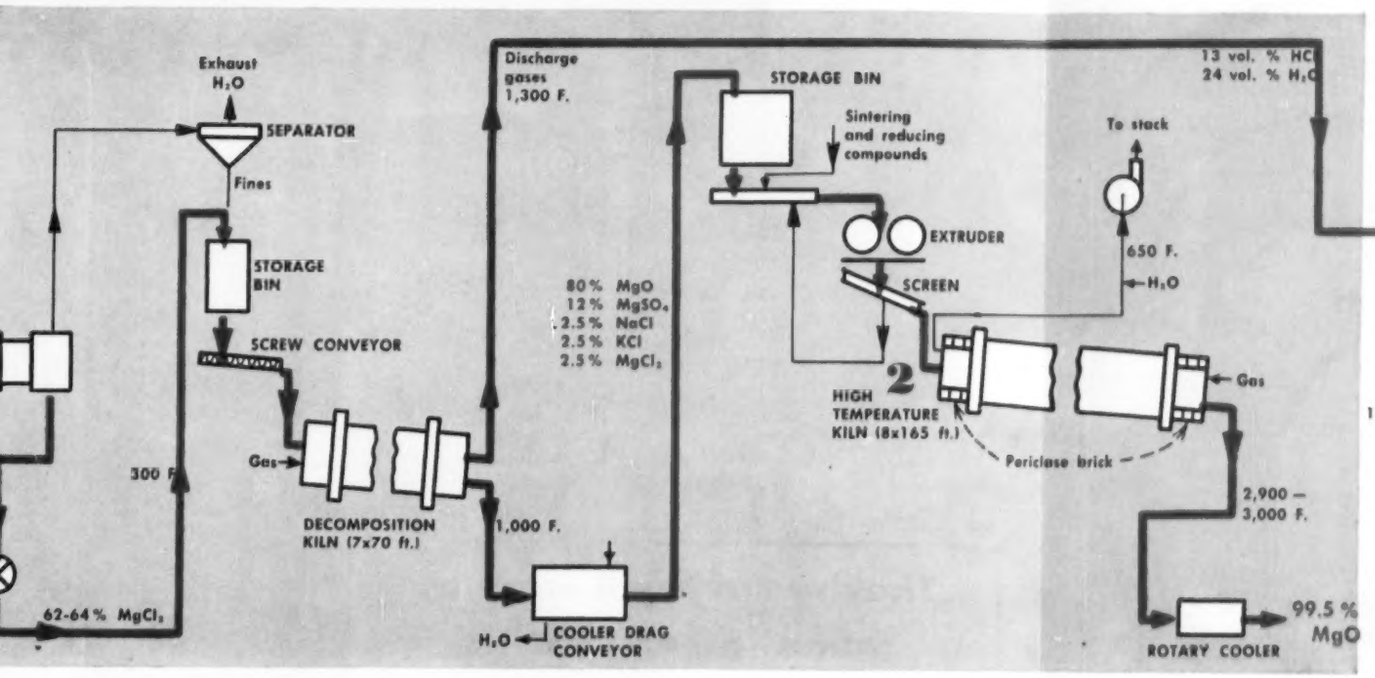
It is further concentrated in a second tower where it partially strips HCl from a descending stream of concentrated acid. The gas exits at 124 F.

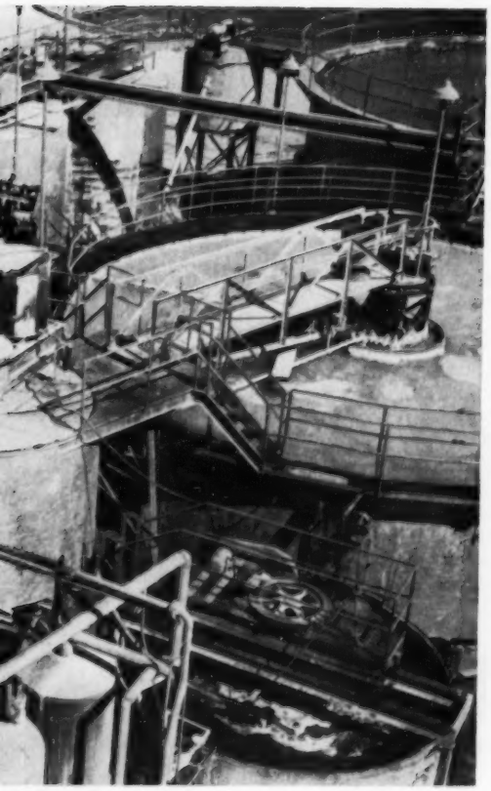
In the third tower the gases are cooled to 112 F. by a countercurrent stream of 30% acid which absorbs enough of the HCl vapors to produce the product—31.5% acid.

Towers are of steel construction lined with acid brick and contain berl saddles.

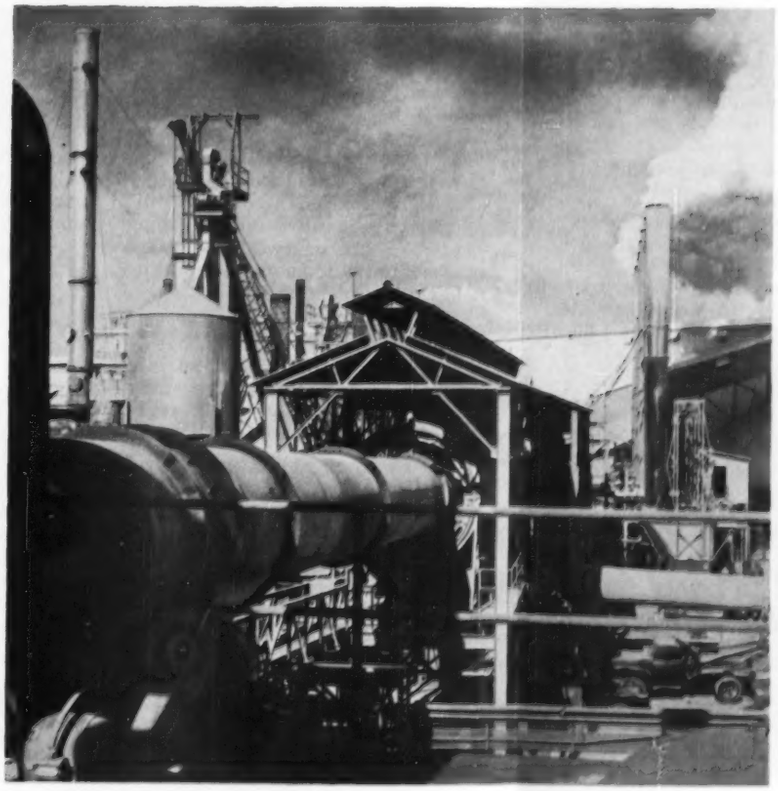


1 REACTION TANKS are steam $6H_2O$ breaks down into KCl crys

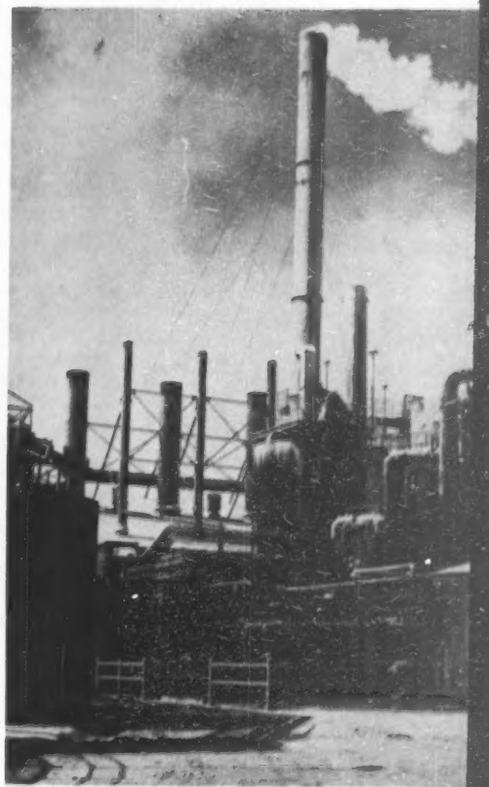




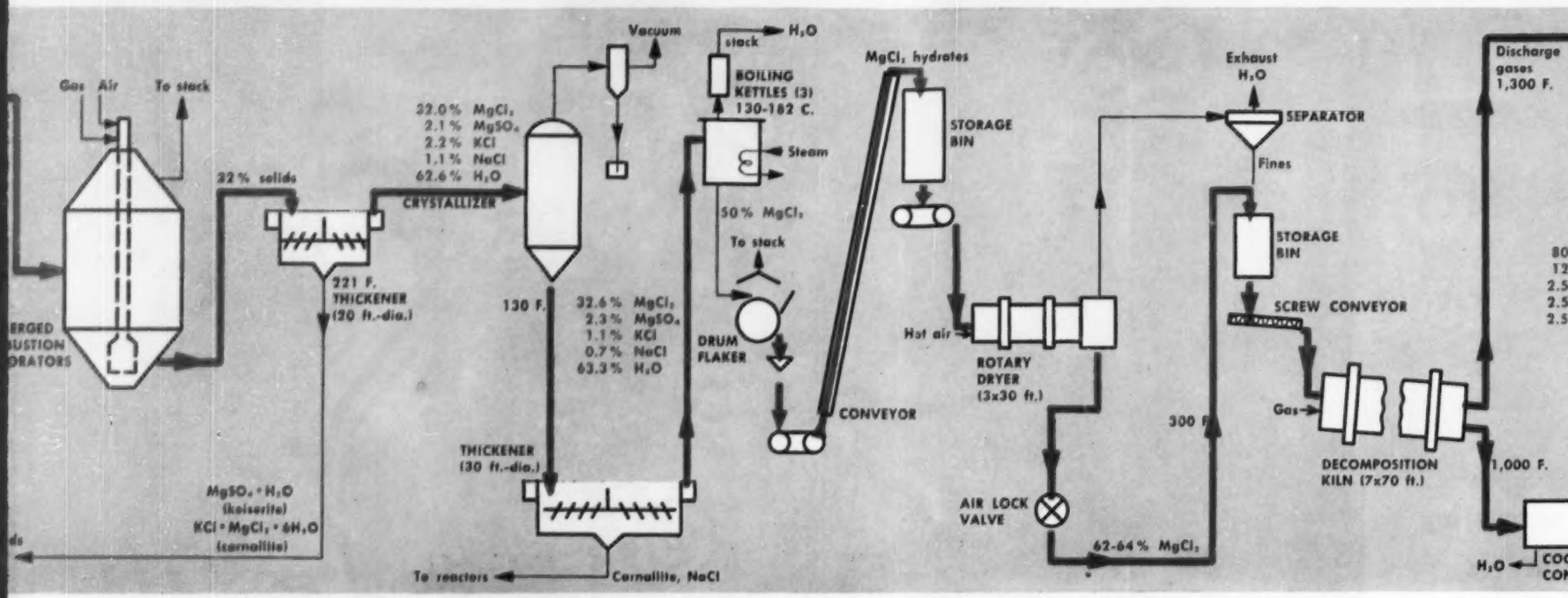
steam heated to 65C. Here carnallite ($KCl \cdot MgCl_2 \cdot$ Cl crystals and a $MgCl_2$ solution.



2 HIGH TEMPERATURE KILN operates at 2,900-3,000 F. and 40 rph. In the kiln $MgSO_4$ decomposes and alkali chlorides volatilize.



3 HYDROCHLORIC ACID UNIT consists of with heat exchangers. A 31.5% HCl is prod



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... Cooled flakes

are made up of a mixture of hexahydrate and tetrahydrate magnesium chloride. These feed into a Roto-Louvre dryer.

► **Converting to MgO** — Dry flakes (62-64% $MgCl_2$) go to the rotary decomposition kiln. Decomposition of $MgCl_2$ hydrate is complete here at a discharge temperature of 1,000 F. Heat comes in through a 6-in. gas burner at the feed end of the kiln (2,200 Btu./lb. feed).

The combined decomposition and combustion gases (13% by vol. HCl, 22-24% H_2O) leave the discharge end at 1,300 F., then pass through a steel duct to the HCl unit.

Product from the decomposition kiln: 80% MgO, 12% $MgSO_4$, 2.5% NaCl, 2.5% KCl and 0 to 2.5% $MgCl_2$. It discharges into a water-cooled drag conveyor with stainless steel troughs, then to storage bins fitted with feeding mechanisms for adding reagents or sintering compounds.

Actual mixing takes place in a screw conveyor which passes the material into a double roll pelletizer. Pellets are screened before entering the high-temperature kiln.

► **High Temperature Kiln**—In a 165-ft. rotary kiln the remaining alkali chlorides volatilize, and $MgSO_4$ decomposes—producing a 99.5% MgO. The kiln is lined with periclase (MgO) brick at the feed and discharge sections. It rotates at 40 rph., has two burners for combustion of 350-400 cfm. natural gas. Temperature in product zone is 2,900-3,000 F. Combustion gases leave at 1,400 F.; cooled to 650 F. with air, they exhaust through a stainless fan and steel stack.

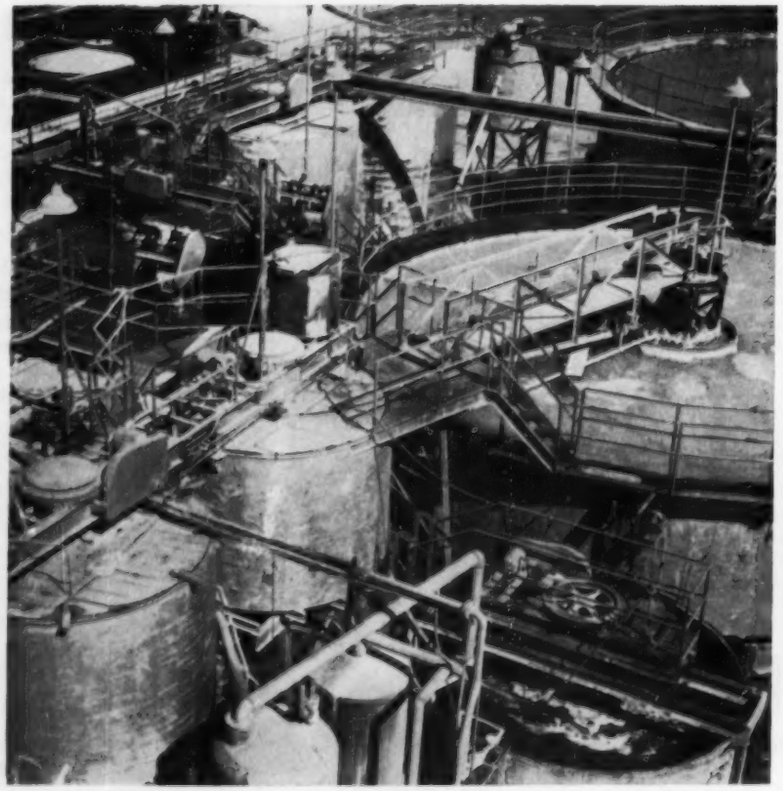
Product (pellets) discharges into a rotary cooler lined with 6-in. periclase brick.

► **Making Hydrochloric Acid**—Flue gas (13% by vol. HCl) is cooled in the first packed tower from 1,250 F. to 188 F. with recycle acid.

It is further concentrated in a second tower where it partially strips HCl from a descending stream of concentrated acid. The gas exits at 124 F.

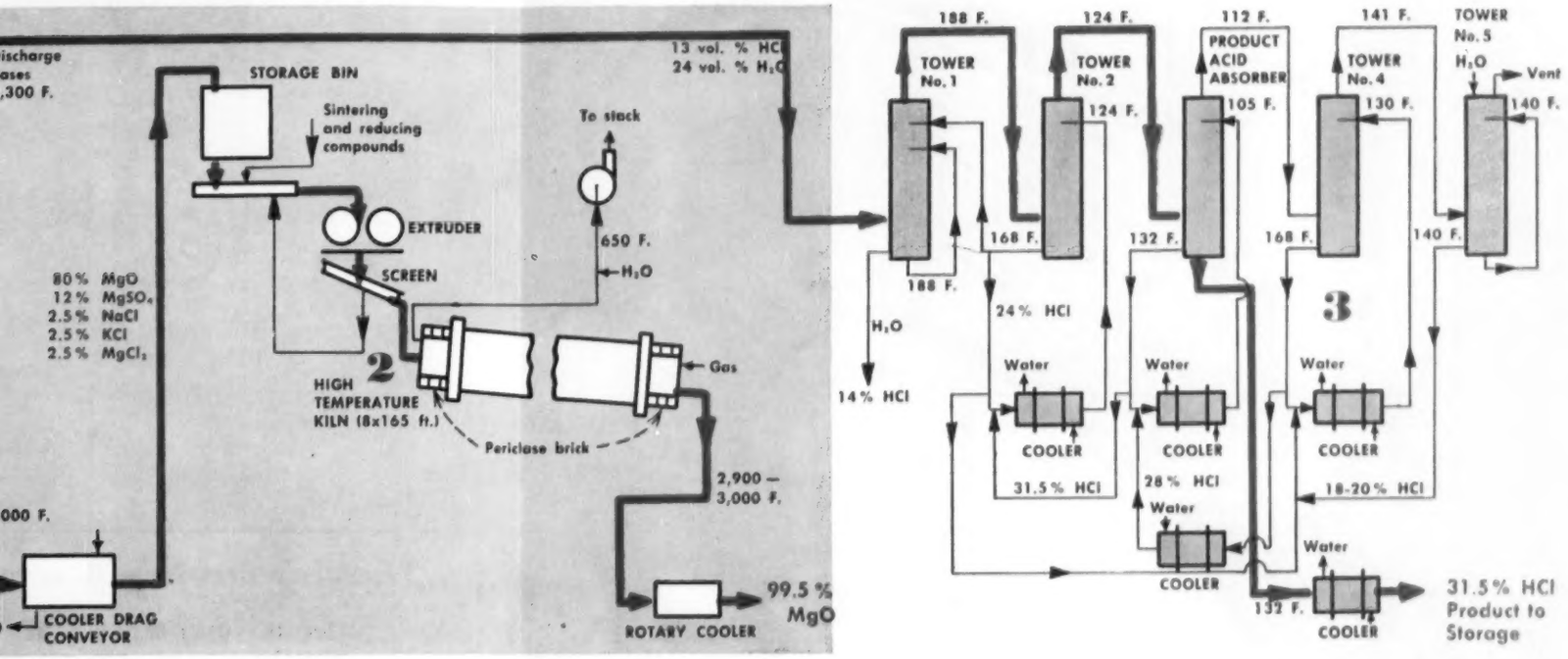
In the third tower the gases are cooled to 112 F. by a countercurrent stream of 30% acid which absorbs enough of the HCl vapors to produce the product—31.5% acid.

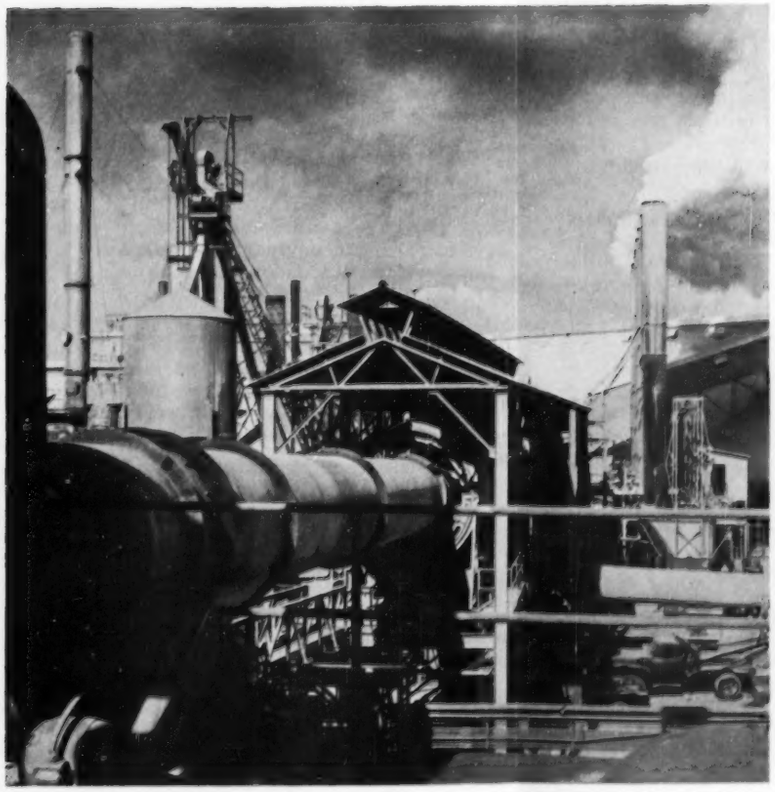
Towers are of steel construction lined with acid brick and contain berl saddles.



1 REACTION TANKS are steam heated to 65C. Here carnallite ($KCl·MgCl_2·6H_2O$ breaks down into KCl crystals and a $MgCl_2$ solution.

2





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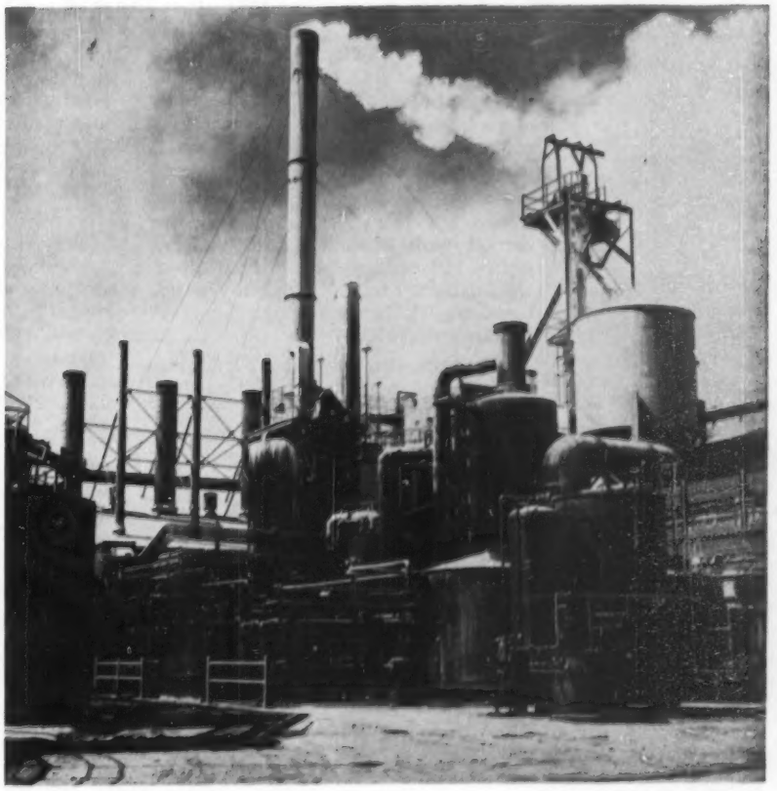
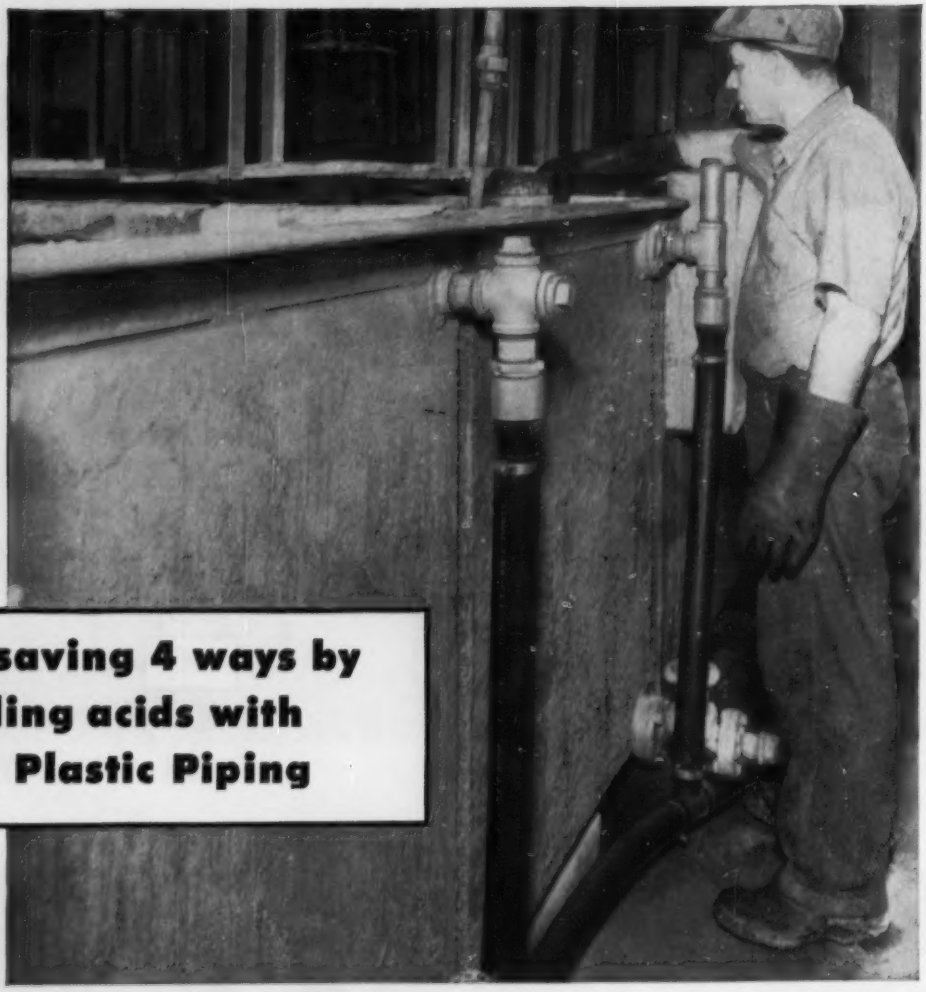


3 HYDROCHLORIC ACID UNIT consists of five packed absorption columns with heat exchangers. A 31.5% HCl is produced from flue gas.



They're saving 4 ways by handling acids with Crane Plastic Piping

THE CASE HISTORY— Globe-Union Inc., leading storage battery builder, in its Milwaukee plant, might have decided plastic piping wasn't for them and let it go at that. Instead, they gave Crane plastic products a fair trial, and here are the results.

On hydrochloric acid lines to zinc-plating tanks, the metal pipe and fittings formerly used had to be replaced completely about every month. Corrosion was the cause.

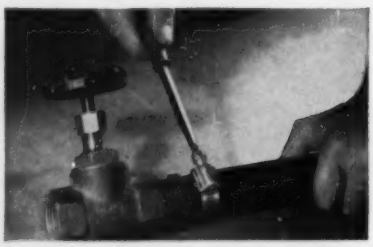
With Crane polyethylene pipe and Crane plastic fittings in this same service, after more than 3 months there is no sign of deterioration and no apparent need of early replacement.

On battery test tanks, Crane plastic piping, exposed to built-up sulphuric acid concentration, looks good as new after more than 4 months' service.

Savings with Crane plastic piping are adding up 4 ways. Plastic cancels the need for costlier metal pipe. It is installed in a fraction of the time it takes for metal pipe and fittings. It reduces installation to a one-man job with simple hand tools. The longer life of plastic is saving replacement, maintenance and housekeeping costs.

Proved in severest services, Crane plastic piping is giving Globe-Union equal satisfaction on many low-pressure air and water lines. Here freedom from sweating is another advantage of plastic.

Once you know the facts of quality-designed, quality-made Crane polyethylene pipe and Crane plastic insert fittings, you, too, will see many opportunities for saving with this modern piping. Call your local Crane Representative today, or write to address below.



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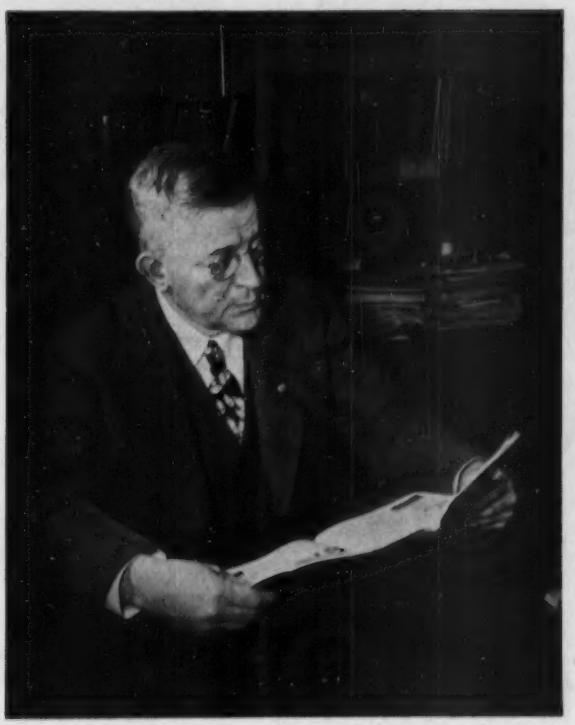


Edgar C. Britton: Man of the Month

Head of Dow Chemical research lab is slated to get the 1956 Perkin Medal of SCI's American Section

The American Section of the Society of the Chemical Industry will award this year's Perkin Medal to Edgar C. Britton, director of the Dow Chemical laboratory which bears his name. Britton earned the award in recognition of his outstanding achievement as an industrial chemist.

▶**The Why of It**—Talented, interesting people are usually a composite of fascinating paradoxes. Yet, very often we're a bit taken back when we see these paradoxes because the lack of rich variety in less creative men often leads us to think in terms of types rather than in terms of actual people.

And so, in a man like Edgar Britton, we're pleasantly surprised when we find this exceptional student—something of a bookworm—has such an easy way of talking to people and getting along with them. And, you don't really expect this man—who has such a fresh, lively imagination and who can dig up minute details out of the past as the drop of a hat—to have an equal command of common sense and a love of the practical side of everyday life.

In his case, as with many other talented men, these contradictory traits do more than merely supply subject matter for interesting conversation. They also tell you a lot about the man himself, why his chosen career shaped up as it did, and why, in Britton's case, he rated this fiftieth presentation of the Perkin Medal.

▶**The Facts**—Sizing up Britton's accomplishments is no simple job. You get some idea of the volume of work he's turned out through a glance at the long list of his published work the total number of patents he holds—some 254—and the fact that he is sole or senior party to some 240 inventions. And while you're being impressed by the prolific volume of his work, you can't help but notice its variety.

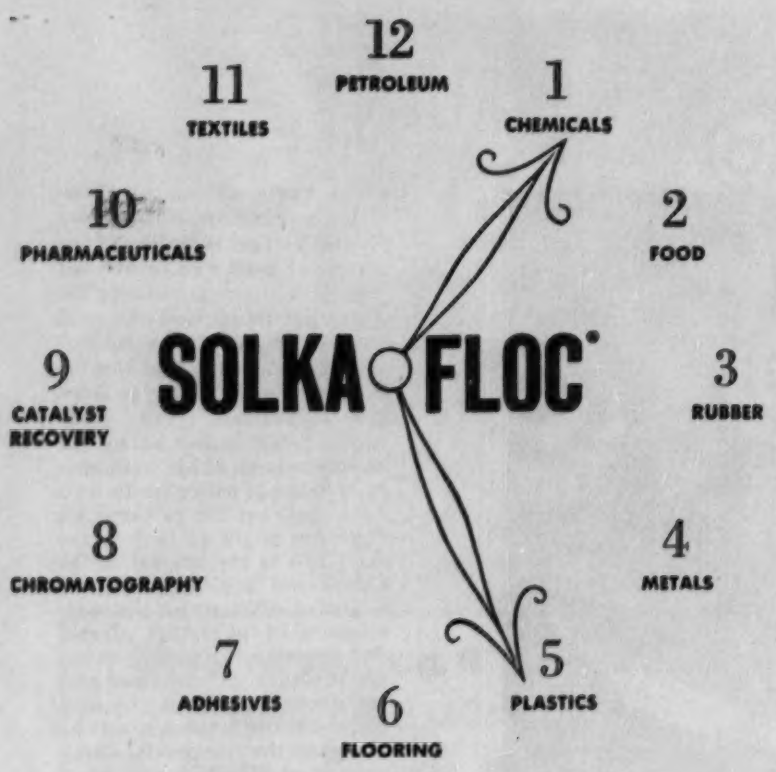
To spell out his career a bit more you might go back to the early 20's to his interest in the commercial application of the Grignard reaction for the manufacture of phenethyl alcohol and its more recent use in the manufacture of intermediates for silicones. A lot can be said, too, about the important role he played in the commercial development of ethylcellulose, vinylidene chloride and styrene plastics, a field in which he earned 54 patents.

He was also one of the first to become interested in synthetic rubber. He had pushed the manufacture of butadiene and acrylonitrile to an advanced pilot plant stage of development by the time war was declared, and the first tank car of butadiene to be shipped in the U. S. was manufactured by a process on which he has been awared patents.

Still another facet of his work —which may some day have far reaching implications to mankind—is the fact that he has made available, either in semiplant or commercial quantities, all of the amino acids which are essential to man.

But the heart of his work is in a field in which 70 patents bear his name—that of phenol and its derivatives.

One of his first assignments in the industrial laboratory was to assist in working out the details of hydrolyzing chlorobenzene to phenol. As soon as the process was in operation all of the usual problems arose as to how to isolate and utilize the by-products and later, how to synthesize the "by-products" when the demand for them became greater than their availability from the original process. (*Continued*)



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In the fields indicated above, and many others, leading manufacturers have taken the time to study and apply SOLKA-FLOC—and saved money!

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SOLKA-FLOC IS ALSO AN OUTSTANDING FILTER AID

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NAMES . . .

With chlorine and bromine available, methods were worked out for manufacturing a wide variety of halogenated phenols and phenol derivatives. About 20 of these derivatives have already been marketed for some years now and the compounds themselves—as well as many of their uses—were developed under Dr. Britton's leadership.

▶**The Summing Up**—At the present time, 200 phenols and phenol derivatives are offered on the market by Dow. And people in Midland say that his command of theory, his understanding of co-workers, his ability to reach out of the bounds of past experiences into new and varied fields of discovery, and his real gift in sizing up these discoveries for everyday use—all made him quite an asset to have around the firm.

They say he played an important part in the development of nearly everyone of the 200 items marketed in that field.

John A. Cushman has been appointed manager of American Viscose Corp.'s plant at Marcus Hook, Pa. Since 1947, Cushman has been chief plant engineer at the firm's Lewistown, Pa., rayon plant.

Michael Pisetzner has been elected vice president and general manager of American Molding Powder & Chemical Corp. and of A. Bamberger Corp.

Clifford J. Backstrand, president of Armstrong Cork Co., has been named to represent the textile and chemical products industries on the Nat'l Advisory Council for the new products exposition to be held in Detroit, in October.

Theron T. Chapel is now product control supervisor for Acheson Colloids Co. **James S. Crowl** has been named supervisor of process research. Crowl replaces **Erwin Campbell** who is now product development supervisor.

D. W. Lowe has been named chief engineer of C. W. Davis & Son, Inc., Huntington, W. Va., industrial piping concern.

William F. Amon, Jr.

New associate director of research and development for new materials at Narmco, Inc., San Diego, Calif., is William F. Amon, Jr.

Prior to his present appointment, Amon was associated with Monsanto Chemical Co., in St. Louis, in the capacity of manager of new product development and with Minnesota Mining & Mfg. Co. as manager of commercial development.

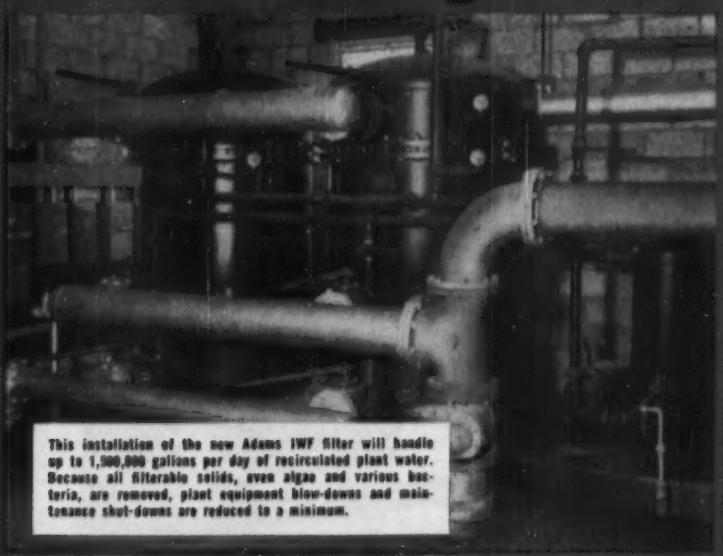
Narmco's San Diego industrial research laboratory is engaged in the development of structural adhesives, reinforced plastics and sandwich structures.

Charles N. Frey, lecturer and consultant at MIT, has received the 1956 Honor Scroll of the New York chapter of the American Institute of Chemists, for his "professional accomplishments during a distinguished scientific career."

L. W. Hamilton has been promoted to group leader in the process development section of the research and development department of American Oil Co., Texas City, Tex.

NYU's College of Engineering has appointed four new members to the Advisory Committee of the research division: **Tom Chilton,** technical director of Dupont's engineering division; **Werner Duecker,** manager of Texas Gulf Sulphur's research department; **Emil Ott,** vice president of Food Machinery & Chemical's central chemical research; and **Roy Walters,** vice president at General Foods.

Announcing . . .



This installation of the new Adams IWF filter will handle up to 1,500,000 gallons per day of recirculated plant water. Because all filterable solids, even algae and various bacteria, are removed, plant equipment blow-downs and maintenance shut-downs are reduced to a minimum.

the NEW ADAMS IWF Industrial Filter

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- Coolant Water
- Make-Up Water
- Secondary Recovery
- Boiler Feed
- Bearing Water
- Potable Plant Water
- Waste Water Disposal
- Process Gases

Adams IWF filters are available in a wide range of sizes and multiple combinations. Cleaning is accomplished without disassembly by the unique Adams HI-FLOW backwash design.

The new IWF is only an addition to an extensive line of Adams filters. So, if you have any filtering problem, fill in the coupon below for further information and help.

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NAMES . . .

John E. Bell

Sinclair Refining Co.'s new chief engineer of the manufacturing department — John E. Bell—took over his duties in June. He succeeded Tom D. Tifft who is retiring after 36 years with the firm.

Recently, he had charge of the central engineering department at Sinclair's East Chicago, Ind., refinery. Earlier in his career, he served as project engineer on construction of the firm's Corpus Christi, Tex., refinery. Bell first came to Sinclair in 1934 as a member of the research and development department.

Bell is a graduate of Rensselaer Polytechnic Institute and received his master's degree in chemical engineering from MIT.

Ernest H. Volwiler, president and general manager of Abbott Laboratories, was elected president of the American Drug Mfrs. Assn.

Herbert Yeagley has joined American Potash & Chemical to head up the firm's newly established Washington office. **Ralph Vreeland** has been named plant process engineer at the firm's Los Angeles plant.

Carlyle M. Ashley, chief staff engineer at Carrier Corp. has been named president of the American Society of Refrigerating Engineers. **Everett Palmatier,** the firm's director of research, has been elected to the society's board of directors.

Theodore Dougherty, group leader in the process develop-

ment department of Carbide & Carbon Chemicals Co., has accepted a position with Union Carbide Development Co., in New York.

Walter Hindle, associate director in charge of dyeing and finishing for Chemstrand Corp., has been promoted to the newly created position of associate director in charge of textile research operations.

M. W. Reynolds and **P. C. Buck** have been elected to the board of director of Acheson Industries, Inc. Till now, Reynolds has been a vice president of the firm. His new duties include a vice-presidency of the international development division.

Ira A. MacDonald has been appointed a chemist in the product development dept. of Atlas Powder's chemicals division.

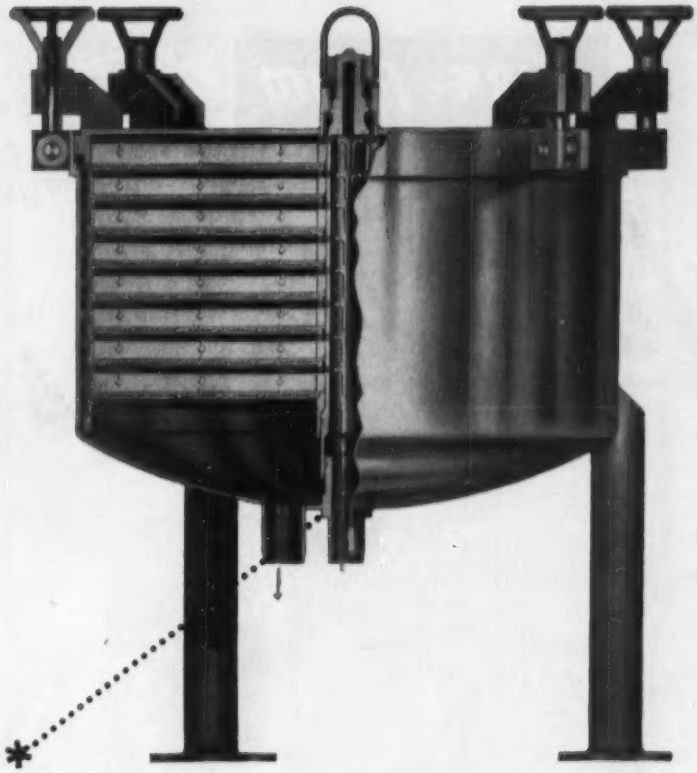
R. C. Buehler and **Fred B. Greusel** have joined the staff of the chemical engineering division of Midwest Research Institute in Kansas City, Mo.

T. H. Goodgame

Texas Butadiene & Chemical Corp. has named T. H. Goodgame its new head of research and development.

Dr. Goodgame completed his master's degree at Louisiana State University and later received a doctorate at MIT. Before joining the Texas firm, he worked with Godfrey L. Cabot, Inc., Boston, Mass.

During World War II, Goodgame served as an engineering officer in the U. S. Navy Submarine Service. He is an active



Look, no heel!

New "Batch-Miser" horizontal plate filter recovers 100% of both liquid and solids — without scavenging. Slurry flows under pressure directly to plates from a central manifold . . . then through filter medium. Filtrate flows into tank . . . and through bottom outlet near center of tank.

And there's no leakage, no warping of plates. A pressure ring (integral with cover) bears on rim of top plate. As cover is tightened, pressure is exerted on plate assembly *equally* around its perimeter. And without troublesome tie rods, down-time is considerably less.

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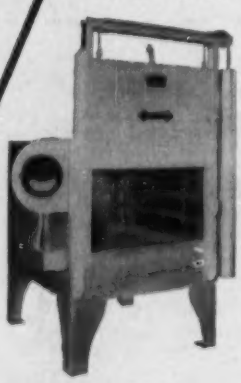

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member of the AIChE, the ACS and a registered professional engineer.

Brig. Gen. Marshall

The first New York Chemical Corps reservist to attain the rank of general is the former Colonel Theodore H. Marshall. Active for many years in Reserve affairs, General Marshall has served since September 1955 as senior chemical officer in charge of mobilization designation detachment #10.

In civilian life, General Marshall is associated with the Lederle Laboratories, American Cyanamid Co.

Raised in Waterloo, Iowa, he graduated with a B.S. in chemical engineering from Iowa State College in 1927. Prior to World War II, General Marshall taught chemical engineering at Case Institute in Cleveland and later was employed as a professor and head of the chemical engineering department at the University of Kansas.

In May 1942, General Marshall was transferred to Washington to the Office of the Chief of the Chemical Warfare Service where he served as chief of plants and chief of chemical engineering. From December 1944 until the end of the war, he served as deputy to the commanding general and executive officer of the technical command.

Roy C. Harrison has recently accepted a position in the research and development division of the Phillips Petroleum Co. in Bartlesville, Okla. Formerly, Harrison was technical director of the United Chemical Corp., New Mexico.

George Rieveschl, Jr., scientific assistant to the president of Parke, Davis & Co., received an honorary doctor of science degree at the University of Cincinnati's commencement in June.

H. B. McClure has been elected a vice president of Union Carbide & Carbon Corp. and appointed a member of the appropriations committee. **D. B. Benedict** succeeds him as president of the firm's division: Carbide & Carbon Chemicals Co.

Charles W. Niederauer has been named methods and planning advisor for the chemical, paint and metallurgical department of Merritt-Chapman & Scott Corp.

Karl Ellingson of Norfolk, Va., has been appointed general manufacturing superintendent of Monsanto Chemical's John F. Queeny plant in St. Louis, Mo. Till now, Ellingson has managed the Norfolk plant.

Hans M. F. Fischer

W. Ward Jackson, vice president in charge of Commercial Solvents' petrochemicals division, has a new assistant—Hans M. F. Fischer.

Formerly, Fischer was assistant to the general manager of the firm's petrochemicals production department. In his new job, he succeeds Thomas Potter who is now associated with Northwest Nitro-Chemicals, Ltd., a CSC affiliate.

Fischer joined the firm in 1933 as a member of its Terre Haute, Ind., production staff. His work with CSC has included research engineering, manage-

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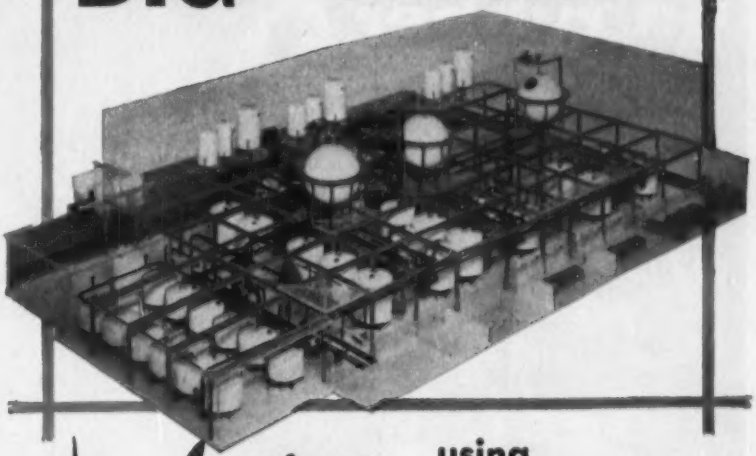


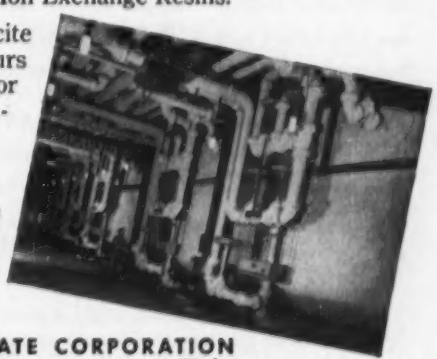
Nalcite® (DOWEX*) **using ION EXCHANGE RESINS**

BUILDING and operating a giant demineralization plant, like the one shown in model form above, are most impressive achievements. Unseen, yet vital, are the materials for which the whole plant is designed: the ion exchange materials used.

In this demineralizer, as in many other installations, Nalcite Ion Exchange Resins do the job efficiently . . . with both high capacity performance and outstanding resistance to attrition losses.

Whether your demineralization needs call for a pint an hour or thousands of gallons per minute—make sure the chemicals that do the job are Nalcite Ion Exchange Resins.

Technical data on Nalcite Ion Exchangers are yours for the asking. Write for this valuable information today.

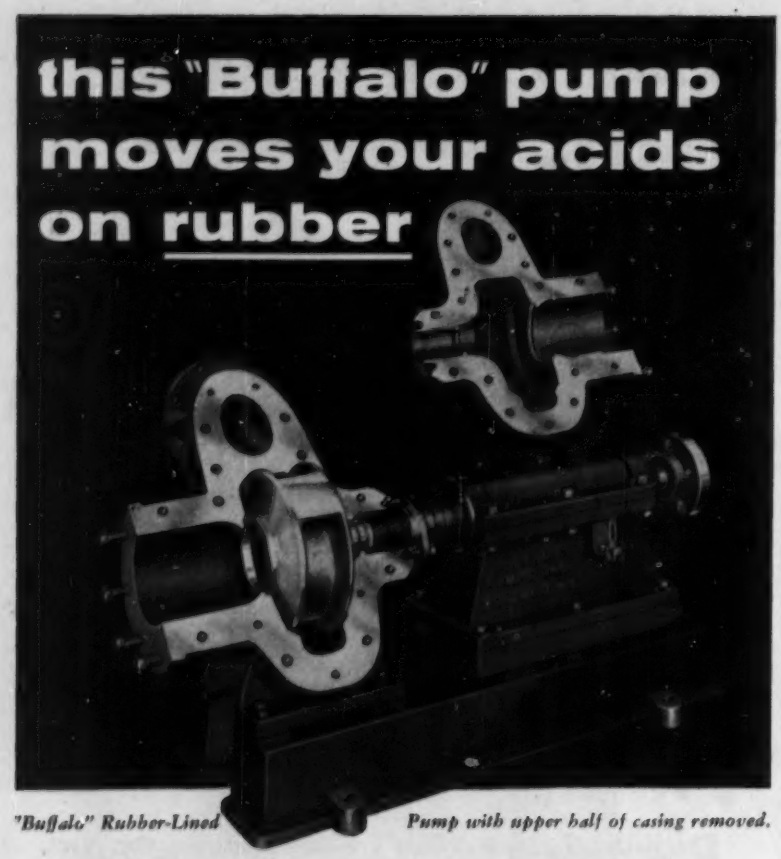


The model grows up. Section of demineralizer plant modeled above—one of world's largest—showing some of automatic control features.

NATIONAL ALUMINATE CORPORATION
6236 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario
*Reg. Trademark of The Dow Chemical Company.

Nalco **When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.**

this "Buffalo" pump moves your acids on rubber



"Buffalo" Rubber-Lined Pump with upper half of casing removed.

—REDUCING COSTLY DOWN-TIME

—ELIMINATING EXCESSIVE REPLACEMENTS

If you are pumping highly corrosive liquids, or liquids containing abrasive solids, you may be paying the high price of short pump life. However, where such severe service destroys ordinary pumps in a hurry, "Buffalo" has the answer: *what acids can't touch, they can't hurt.* And in this "Buffalo" Pump, the liquid contacts nothing but rubber, vulcanized to the impeller and passages.

Pump life is multiplied many times and the cost of rubber lining is negligible when compared to the savings in down-time and replacements. Have us mail you Bulletin 982 — see this and the other "Q" Factor* features that save you money and troubles when you specify "Buffalo" Chemical Pumps.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

"Buffalo" PUMPS

BUFFALO PUMPS

DIVISION OF BUFFALO FORGE CO.

501 Broadway Buffalo, N. Y.

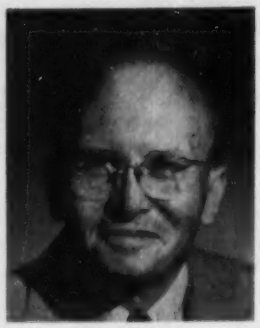
Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

NAMES . . .

ment of the Terre Haute, Ind., plant and, most recently, responsibility for diversified petrochemicals production.



D. S. Davis

The "nomograph king," Dr. D. S. Davis, leaves his professorship at the Virginia Polytechnic Institute to become professor of engineering and to take charge of engineering orientation at the University of Alabama in September.

Since his graduation from MIT, Davis has balanced teaching and work in industry through various appointments the University of Vermont, Wayne University, VPI, International Paper Co., Mead Corp., Wyandotte Chemicals, and Hercules Powder.

And, in the interim, he has turned out 337 technical papers, three books on nomography, one on report writing, sections of Perry's "Chemical Engineers' Handbook," "Chemical Business Handbook" and Weil's "Technical Report." He has also managed to write and act in numerous radio comedies.

Al Giusti has been named senior engineer in the instrument department at Monsanto's Texas City, Tex., operations. **Raymond Rosenberg** holds a similar position in the technical service department.

Dr. Max Bender has been elected chairman of the New Jersey chapter of the American Institute of Chemists. Bender is a senior research chemist with the Bound Brook, N. J., labs of American Cyanamid.

Gordon Kiddoo, vice president of National Research Corp., has been elected vice presi-

dent and general manager of NRC Metals Corp. The latter firm has recently signed a $22¾ million contract with the AEC to supply 700,000 lbs. of zirconium metal for a 5 year period.

J. T. Benedict has joined International Nickel Co.'s Bayonne Research Lab staff, as a member of the electrochemical section.

Walter Zinn, director of Argonne Nat'l Laboratory, has agreed to serve as part time technical consultant to the Joint Congressional Committee on Atomic Energy.

Frank L. MacArtor has been appointed senior project engineer in Atlas Powder's economic evaluation department. Mac Artor comes to Atlas from Commercial Solvents Corp.

Ernest T. Handley has been appointed executive vice president of Firestone Plastics Co., Pottstown, Pa. Handley has been vice president in charge of production of the plastics firm and continues as general manager of the Pottstown plant.

R. L. Langerhans has just been appointed to the staff of the Tonawanda, New York, Laboratories of Linde Air Products Co. He'll work in the development group on Linde's new molecular sieve absorbents.

S. Philip Marcus will be business manager of the Princeton center of long-range research programs conducted by Food Machinery & Chemical Corp. (chemical divisions).

Harry A. Brown has resigned as vice president in charge of manufacturing of Frontier Refining Co., Cheyenne, Wyo., to join D-X Sunray Oil Co., Tulsa, Okla., as vice president in charge of refining.

John Sabot, senior chemical engineer at Goodrich-Gulf Chemicals, Inc., plant in Port Neches, Tex., has been trans-

GIVES YOU BEST

Performance

Because it's Best Suited to the Job

WELDCO Always Meets Your *Specifications*

TO GET TOP-QUALITY TUBING made to your individual needs, it's always good business to specify Weldco. For Weldco is produced by tubing specialists—men who have the equipment, facilities and experience to manufacture tubing to your exact specifications. Weldco is automatically machine-welded under pressure, properly formed, carefully finished, accurately sized and straightened, and rigidly checked.

Only Weldco Tubing is welded with the exclusive Double-Fusion Process. It's available in Stainless Steel, Monel, Inconel, Nickel, Cupro-Nickel, and Hastelloy, in tube and pipe sizes from 3" to 30", Schedules 5 and 10, and 3" to 12", Schedule 40. To insure top performance and long service life, make Youngstown Welding your tubing headquarters. A letter or phone call puts our 39 years of specialized experience to work for you.

Whatever Your Needs In Tubing... You're Way Ahead With WELDCO

THE YOUNGSTOWN WELDING & ENGINEERING CO.

3712 OAKWOOD AVE. · YOUNGSTOWN 9, OHIO

Pumping Progress Report

FOR CHEMICAL ENGINEERS

An advertisement prepared by the Aldrich Pump Co., Member of Hydraulic Institute, U.S.A.

SPACE, in many pump installations, is a major problem. Another is the necessity for special foundations. When new installations are considered, these factors may dictate more elaborate construction than should be necessary. And for replacement or modifications of existing systems, they may require expensive piping and equipment changes.

COMPACTNESS OF DESIGN, while often desirable, is not necessarily the answer. Simplicity of design — as in the case of ALDRICH Direct Flow Pumps — may be a better solution.

SIMPLICITY OF DESIGN brought about the first inverted Triplex and Quintuplex Pumps and ultimately Septuplex and Nonuplex Pumps. This Aldrich design innovation brought to pump users many economies of space, maintenance and operation they had never known.

INVERTED PUMP DESIGN permits the use of less expensive foundations. With the crankshaft located near the floor there is no need for expensive foundation work to raise the driver or lower the pump. Then, too, inverted pumps require fewer square feet of floor space than conventional pumps.

MAINTENANCE COSTS ARE REDUCED. Fluid-end, where most work is done, is at chest level. Bearing replacements are made without removing heavy crankshafts or connecting rods. Crossheads on all Direct Flow Pumps can be worked on or removed from pump without disturbing fluid-end.

TELL US ABOUT YOUR PUMPING PROBLEM. The chances are that one of our standard pumps — or a modification of one — will do your job. Detail your problem and we'll send you a copy of the Data Sheet that describes the Direct Flow Pump we recommend. Write to: The Aldrich Pump Company, 3 Gordon St., Allentown, Pa.

NAMES . . .

ferred to the firm's main offices in Cleveland, as project manager.

Myron W. Kiebler has been appointed manager of the Glidden Co.'s new multi-million dollar chemical plant now under construction at Port St. Joe, Fla.

William S. Mitchell has been named manager of technical soybean oil sales for General Mills' soybean division, in Minneapolis.

Stuart C. Dorman has been promoted from executive vice president to president of Gulf Sulphur Corp., Houston, Tex. He was formerly a vice president of the McGraw-Hill Book Co.

Anthony J. Bruno, Jr., has been appointed technical department head of the multi-million dollar polyolefin resin plant now under construction for W. R Grace & Co., polymer chemicals div.

Walter J. A. Connor has been elected president of American Plastics Corp., subsidiary of Heyden Chemical Corp. Before coming to the firm, some ten years ago, Connor was associated with Celluplastic Corp.

Gordon K. Storin, of Hooker Electrochemical Co., Niagara Falls, N. Y., has been elected chairman of the Empire State Section, of the Technical Assn. of the Pulp & Paper Industry.

Glenn E. Seidel has been appointed to the newly-created corporate position of vice president in charge of engineering for Minneapolis-Honeywell Regulator Co. Since 1952, Seidel has been vice president in charge of engineering in the firm's Minneapolis plant.

Richard C. Burck has been promoted to the position of product development supervisor for the Mobay Chemical Co. in St. Louis. **Horace O. Kippels** is now a senior engi-

neer in the New Martinsville, W. Va., design engineering department.

Frederick Gilbert

Slated to succeed Dr. Max E. Bretschger, as president of Becco Chemical Division, Food Machinery & Chemical Corp., is Frederick A. Gilbert.

During his past 21 years with the firm, Gilbert has gained a wide variety of experience in research, production and administration. He came to Becco in 1935, as a control chemist—before Becco merged with FMC. In 1951, he assumed management of Becco's peroxygen chemicals plant in Vancouver, Wash. Later, he returned to Buffalo as assistant to the vice president. Then, after the merger, he became vice president and assistant division manager.

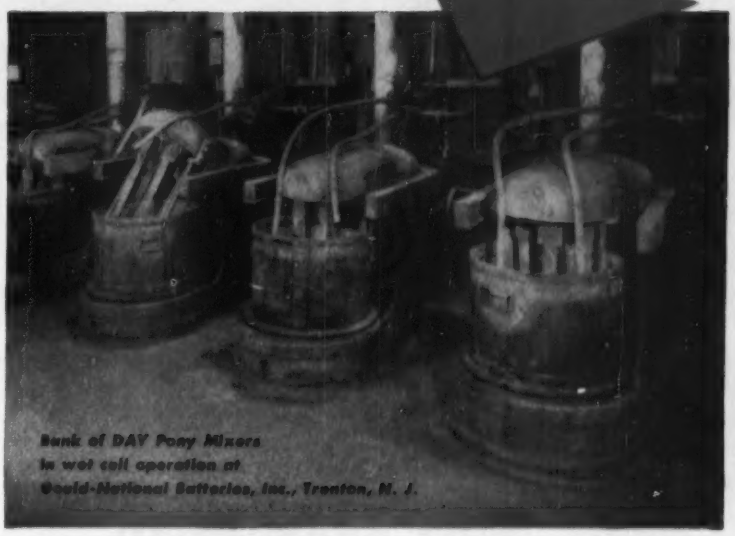
The 44 year old executive is an extensive reader—a student of American history, in particular. He also enjoys bird watching and plays tennis with a fair amount of skill. Society memberships include the AIChE as well as the ACS.

Simon Miron and **R. L. Aiken** have been promoted to the positions of research associate and senior chemist respectively in the research and development department of American Oil Co.

Thomas F. Anderson has been named works manager of the Aluminum Co. of America's Pt. Comfort, Tex., smelting plant. He replaces **Ben Sloane,** who is now manager of the plant.

Claude Ramsey, Jr., has been appointed production mana-

it paid to buy DAY



GOULD-NATIONAL BATTERIES, INC. now blends 250 lbs. of heavy paste in 25 minutes in a DAY PONY MIXER.

Considerable production cost savings have been achieved by this outstanding Company using DAY Pony Mixers. Despite the fact that the product being mixed is very heavy and highly acid, operation is virtually trouble-free.

There are no bearings or stuffing boxes in the product zone. Extra rugged construction assures absolute rigidity. Planetary mixing action plus agitator blade contouring, delivers radial and lifting mixing over entire depth of can.

It will pay you to investigate the increased production plus cost savings you will receive with DAY mixers. Write for Bulletin 500.

FOUNDED 1907

in mixing equipment DAY *means longer life span*

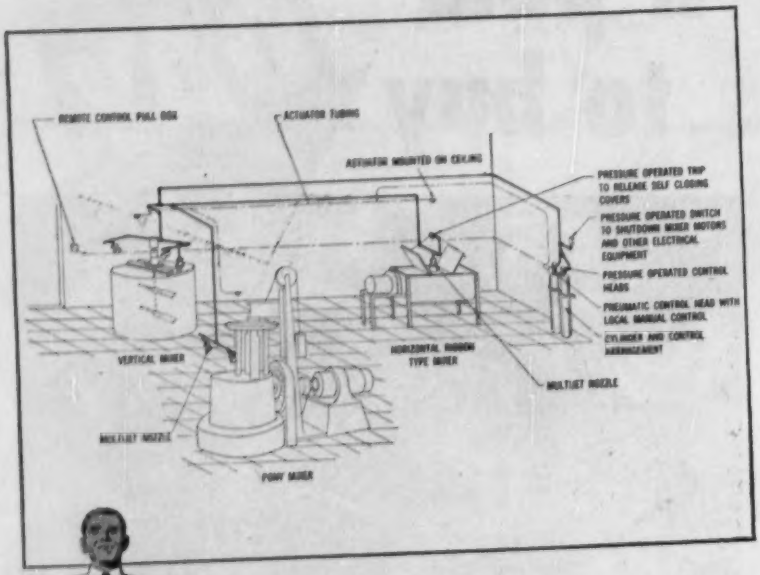
THE J. H. DAY COMPANY

4932 BEECH ST., NORWOOD, CINCINNATI 12, OHIO

Division of Cleveland Automatic Machine Company

Quality equipment for baking, paint and varnish, printing ink, chemical, rubber, pharmaceutical, cosmetics, paper and pulp, explosives, food, ceramics, candy, soap, sugar and milk products.

Eastern Canada: Brantford Oven & Rack Co., Ltd., Brantford, Ontario
Mexico: T. de la Pena e Hijos, S.A., Nazas 45-A, Mexico 5—D.F.


REMOTE CONTROL PULL BOX
ACTUATOR TUBING
ACTUATOR MOUNTED ON CEILING
PRESSURE OPERATED TRIP TO RELEASE SELF CLOSING COVERS
PRESSURE OPERATED SWITCH TO SHUTDOWN MIXER MOTORS AND OTHER ELECTRICAL EQUIPMENT
PRESSURE OPERATED CONTROL HEADS
PNEUMATIC CONTROL HEAD WITH LOCAL MANUAL CONTROL
CYLINDER AND CONTROL ARRANGEMENT
VERTICAL MIXER
HORIZONTAL RIBBON TYPE MIXER
MULTIJET NOZZLE
MULTIJET NOZZLE
PONY MIXER

FULL-TIME FIRE PROTECTION... CUSTOM-ENGINEERED FOR INDUSTRIAL MIXERS!

SPECIAL HAZARDS—like industrial mixing vats shown in the diagram above—deserve special fire protection . . . the *custom-engineered* kind of fire defense that you get with a Kidde CO_2 Fire Extinguishing System!

Fully automatic, the Kidde system provides *'round-the-clock* protection . . . insures full-time security even in case of outside power failures. Rate-of-temperature-rise detectors spot the first sign of flame, and cause Multijet nozzles to discharge fire-smothering carbon dioxide that stifles the blaze in seconds. At the same time, the Kidde system switches off fans and machinery and sounds an alarm.

All moving parts of a Kidde system are self-enclosed to prevent accidental discharge. Easy-to-read visual indicators show at a glance whether the system is "set" or "released." And Kidde Directional Valves let you guard more than one hazard from the same cylinder bank, providing completely versatile fire protection.

Don't settle for anything less than the *best* in fire protection. For more information about your specific problem, write Kidde today.

Kidde

Walter Kidde & Company, Inc.
828 Main Street, Belleville 9, N. J.
Walter Kidde & Company of Canada Ltd., Montreal—Toronto

NAMES . . .

ger of American Enka's new $21 million rayon staple fiber plant currently under construction at Lowland, Tenn. **Gale P. Wait** will succeed Ramsey as administrative assistant to the vice president of manufacturing.

Murray Berdick, coordinator of Research at Evans Research & Development Corp., took office on June 7 as chairman of the New York chapter of the American Institute of Chemists.

James Bennett, chief plant engineer at American Viscose Corp.'s Front Royal, Va., rayon plant, has been appointed engineering consultant to the plant manager.

Howard S. Bryant, Jr., has joined the technical section at Courtaulds (Ala.) Inc., in Mobile. Bryant recently received his doctorate in chemical engineering from Georgia Tech.

William J. Jennings has been elected executive vice president of Crowley Tar Products Co., Inc., New York.

Harry M. Wilson has been named pharmaceutical chemicals sales manager for Commercial Solvents Corp.

WHAT PRICE SECURITY

Jesse E. Hobson, former research director, Stanford Research Institute, asks: "*. . . In the name of security, have we traduced the first principles of successful capitalism?*"

"The major deterrent to nuclear power development is a rampant growth—half law, half policy, and all expediency—and though it has no real name, its pseudonym is 'security.' This concept of information, reveals an aspect as sobering as many megaton equivalent of TNT. . .

"The real security of America is best preserved through the practices of freedom and free enterprise, a fundamental fact of our democratic experience which is apparently lost on some of our bu-

reaucrats. The integrity of secret information regarding weapons and defense must be protected in time of war, even in cold war. But today the selection of what information shall be secret, or what information we shall pretend is secret, is quite another matter. In the name of 'security' our country's leadership in atomic technology is being lost to other nations; our government may be actually suffocating the initiative of free enterprise and denying the rewards of private investment; we find duly established investigating committees unable to get full information. In the name of 'security,' have we traduced the first principles of successful capitalism?

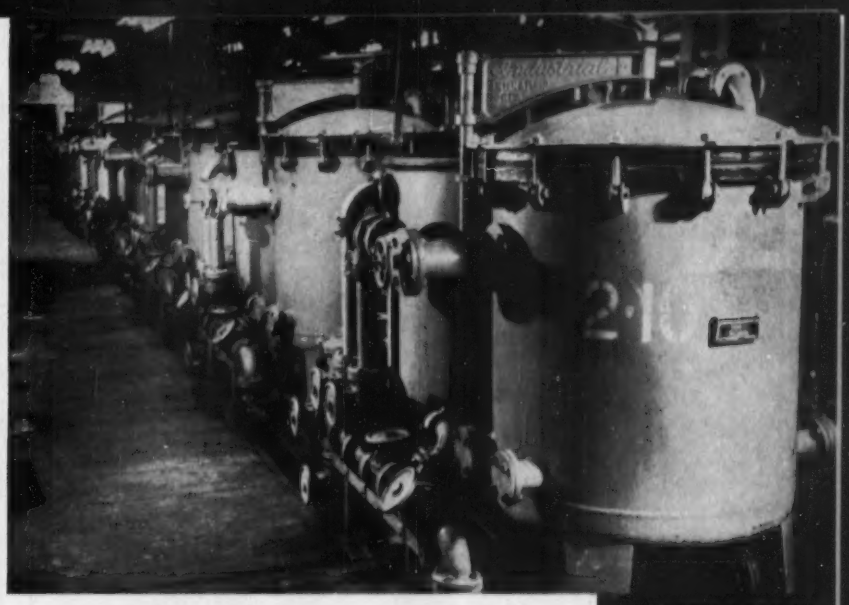
"Industry must compete, blindfolded and hobbled, with tightly controlled and restricted government research programs. This is a public situation of great consequence. . .

"The stimulating influence of this new area of industrial knowledge was held in check for a score of good reasons—in 1946. But this is 1956, and still atomic information flows like glue. And to say that conditions have changed in the last ten years is to barely blink at the subject. . .

"We have seen our handhold, if it ever actually existed, slip and relax over the past decade. We are told that we are only competitive, not supreme, in armed capability. Except in a few fields, we may be in the backwash of peaceful applications. England and the low countries are producing commercial atomic power today, while Senator Anderson, Chairman of the Congressional Joint Committee on Atomic Energy, is still trying to find out why we have lost position. One answer he gets from The Panel on the Impact of the Peaceful Uses of Atomic Energy (1956), Volume 2, page 464 is, in part:

> "'General agreement was reached that if industry demonstrates that it can carry the responsibility for pressing forward with development at the rate required for national interest and prestige, the national laboratory development work should be curtailed. At present industry does not have the required research and development capability.'"

*These excerpts were taken from Jesse Hobson's speech made before the Bituminous Coal Research annual meeting in Columbus, Ohio, April 19.



FILTRATION PROBLEMS?

. . . SEE INDUSTRIAL'S NEW BUILT-TO-ORDER FEATURES

Industrial offers much more than a line of standard filters . . . a complete filtration engineering service from fluid analysis to installation. Industrial is ready and able to help you specify the right equipment for common or unusual needs.

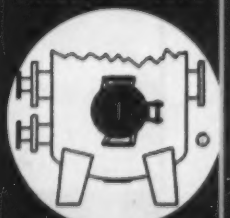
Easily adapted for special uses . . . these Vertical Filters typify Industrial engineering . . . purposely designed to be built for your exact needs.
Several of the many possible modifications are shown at the right . . . for recovery of large volumes of solids the bottom opening filter is ideal; for smaller volumes, the clean out door is more practical and less costly. Another example of specialization is the jacketed shell filter, for use where small temperature variations are important. Other optional features are quick-opening covers, individual leaf outlets and self-cleaning devices that offer sluicing, shaking or air wash cleaning.

Lower filtration cost . . . proven performance, minimum down time, the use of low cost but efficient filter media plus a design exactly suited to your needs, all contribute to Industrial's low over-all cost per gallon of filtrate.

Write now for details on flow systems, special equipment, filter and leaf construction. Ask for 8 page Bulletin 111.

MODIFICATIONS

RECOVERING LARGE VOLUMES OF SOLIDS



RECOVERING SMALL VOLUMES OF SOLIDS

JACKETED SHELL FOR UNIFORM TEMPERATURE

INDUSTRIAL

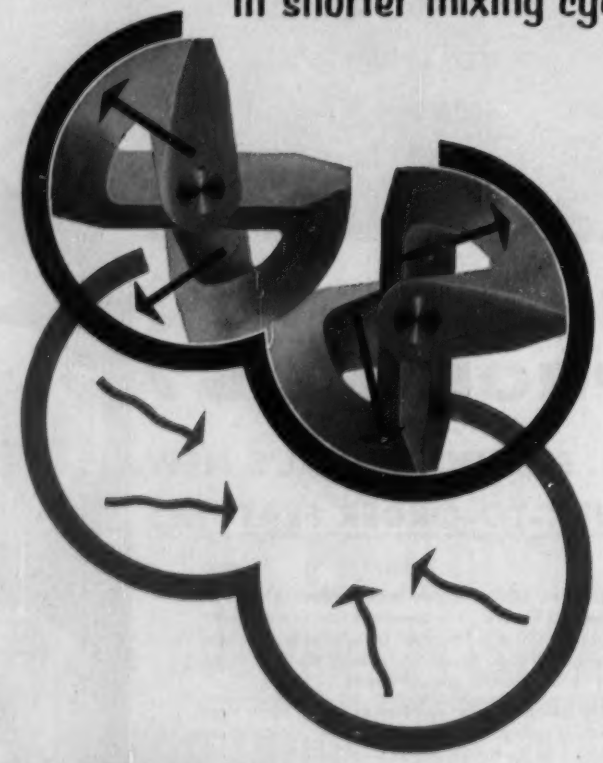
Industrial

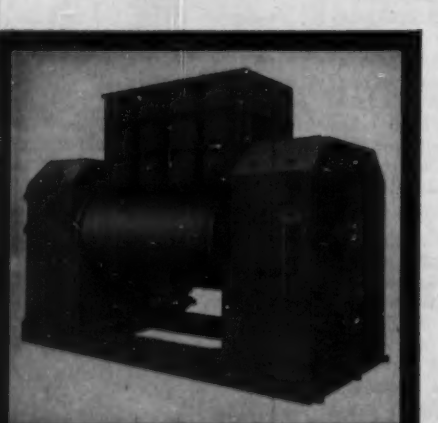
FILTER & PUMP MFG. CO.

5918 OGDEN AVENUE • CHICAGO 50, ILLINOIS

CENTRIFUGAL PUMPS • PRESSURE FILTERS • ION AND HEAT EXCHANGERS • RUBBER LININGS • WASTE TREATING EQUIPMENT

From this unique bowl
...COMPLETE DISPERSION
...MAXIMUM HEAT TRANSFER
in shorter mixing cycle





READ STANDARD
CORPORATION

The unique shape of this mixer bowl presents a greater ratio of heated surface to the mix. Close clearances between the mixer arms and shell eliminate build-up of materials, facilitating heat transfer.

Overlapping sigma-arm mixing action exposes new surfaces and breaks down the entire mass with each rotation, eliminating peak loads and producing a homogenous mix in a short mixing cycle.

Available in capacities up to 750 gallons.

BAKERY-CHEMICAL DIVISION, York, Pennsylvania

Letters:

Pro: Exam Preparation

Sir:

I have read with keen interest Mr. Constance's article in your February issue (p. 208), "How You Can Pass the Registration Exam." I know of no other article which covers the subject as well.

After it has served my purpose I am sending it to the secretary of our State Society that he may also have the privilege of reading it.

L. D. LAMONT
Pottsville, Pa.

Sir:

I read Mr. Constance's article on passing registration exams and feel that I really learned something from it.

LEO DIRICCO
Wilmington, Del.

Sir:

I enjoyed Mr. Constance's recent article and expect to find his hints very helpful in my own examination soon.

H. A. LE SIEUR, JR.
Pacific Chemical & Fertilizer Co.
Honolulu, Hawaii

Sir:

I enjoyed reading Mr. Constance's article, especially the part about the logical approach to the problem and the preparation involved.

EDWARD H. ATKINS
Morton Salt Co.
Manistee, Mich.

Sir:

I am just beginning to make my plans to pass the engineers' exam in Virginia. Since I've been out of school 20 years or so

Pro & Con

C. H. CHILTON

I don't relish the thought—but I want the license!

Mr. Constance's articles in *Chemical Engineering* have been really good, and we appreciate your help in this way.

PHILIP E. STONE
Richmond, Va.

Sir:

Mr. Constance's article concerning professional examinations has aroused much interest.

ARTHUR L. PHIPPS
Barium Products Ltd.
Modesto, Calif.

Straightening the Record

Sir:

While having enjoyed your May article, "Synthetic Fibers Shine Again" (pp. 258-260), I write to call attention to one error in the otherwise excellent story.

Fortisan-36, a high-strength industrial rayon, is a Celanese fiber. I feel sure that our friends at Cyanamid, to whom the fiber was erroneously credited, would likewise want to have the record set straight.

SHERMAN STAMBAUGH
Celanese Corp. of America
New York, N. Y.

Pro: Sound Economic Basis

Sir:

Mr. Jelen's article in the May issue (pp. 165-9) makes a notable contribution to the economic evaluation of engineering alternatives by recognizing the effect of a steadily decaying dollar.

It would be interesting to know why Mr. Jelen used 8% per year as the worth of money, when money can be borrowed at much lower rates. And, in his next article, it is to be hoped he will discuss the special case in which interest rates and inflation rates are equal—a condition which probably has occurred and is likely to occur again.

I would like to enter a special plea for an extension of Mr. Jelen's work to cover the economic evaluation of income-producing capital expenditures, in which the effects of both interest and decay rates will be given

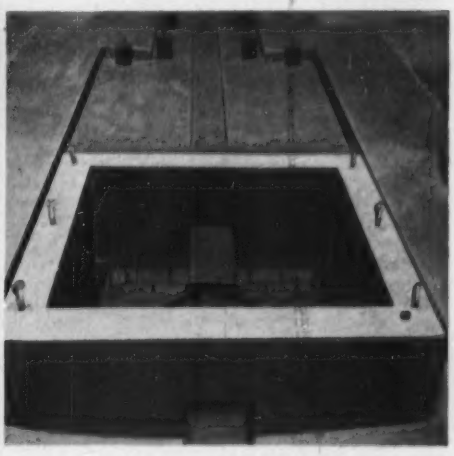
COROCRETE
CORROSION-PROOF
FLOOR
SURFACING

PROVIDES GREATER PROTECTION AGAINST ACIDS AND ALKALIES

COROCRETE is 4 times stronger than concrete . . . it is resistant to abrasion . . . sets up faster than concrete . . . resists impact . . . provides positive protection against acids, alkalies and solvents . . . and COROCRETE costs less than acid-proof brick.

Here is a floor surfacing material that has been developed to meet virtually all of the conditions found in chemical and food processing, plating and metal working industries.

COROCRETE will give you greater protection . . . save you dollars . . . and last longer. Use the convenient coupon to obtain more information or a sample of COROCRETE. Write today.

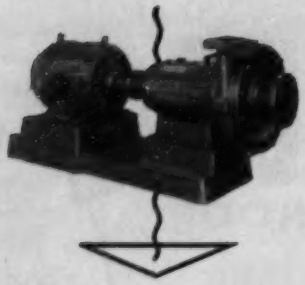


Quickly and easily applied over existing concrete surfaces, COROCRETE handles like cement topping (¼ to ½-inch thickness).

6900-CC

THE CEILCOTE CO., Inc.
Corrosion Proof Material and Construction
4836 Ridge Road • Cleveland 9, Ohio

The Ceilcote Co., Inc.
4836 Ridge Road • Cleveland 9, Ohio
Check one or both:
☐ Please send me a copy of the Brochure
☐ Please send me a sample of COROCRETE
Name _____
Company _____
Address _____
City _____ Zone ____ State _____



How to eat your Cake and have it, too

It's a neat trick if you can do it. And you can when it comes to process pumping. Dean Brothers has a line of heavy duty centrifugal pumps—

—with a range of application that covers fully 90% of all process pumping applications,

—with mechanical reliability usually found only in costly, individually-engineered pumps,

—with a whole raft of standard features considered special on many other pumps,

—at the lowest overall cost for operation, maintenance and replacement.

Here's the "trick": all eleven pumps in Dean Brothers Series C-10 have a single cradle assembly. Only the Casing, Impeller and Suction Nozzle vary with each individual pump's capacity. Everything else is the same throughout the entire series. Such interchangeability made it possible to design and build a cradle assembly that can stand up and take the beating a process pump gets in continuous heavy duty process service—*and still be a good buy.*

If you'd like to eat your cake and have it too, get all the facts about the pumps* that cost you the least in the long run. Send for Circular No. 184B.

**Series 10, Series 20 and Series 30—to 7,000 gallons per minute capacity.*

HOW DEAN BROTHERS ENGINEERS FOR LONG PUMP LIFE

Shaft deflection causes wear on the packing or mechanical seal. So Dean Brothers makes the shaft extra big with properly proportioned overhang to minimize this deflection. Result: Fewer costly, time-consuming replacements of these vital parts.

The bigger the bearings, the longer they last. So the bearings were selected to withstand the maximum possible imposed radial and thrust loads. Result: Bearing life exceeds the time between normal plant maintenance shutdowns.

Everything is like this in these pumps. Their design incorporates recognized engineering codes. Whatever these codes recommend, Dean Brothers standard centrifugal pumps have.

DEAN BROTHERS PUMPS INC.

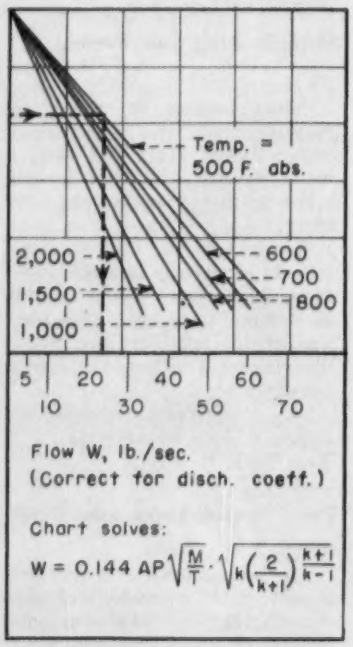
INDIANAPOLIS 7, INDIANA

Centrifugal and Reciprocating Pumps • Since 1869

proper weight. With so many income-producing projects competing for available capital funds it becomes increasingly important to establish a sound basis for economic evaluation.

There is also a need for a realistic method of evaluating over-all corporate performance. What rate of return has actually been earned, in any fiscal year, on a corporation's total invested capital? In practically all of the published figures the effect of inflation is ignored.

SYDNEY STEELE
Atlas Powder Co.
Wilmington, Del.



Pro: Correct Gas Flow

Sir:

In my June Plant Notebook article ("Gas Flow Chart for Orifices and Nozzles," p. 264) you made an error somewhere in the process of reproducing the chart. Because of this error the trial solution does not agree with the text.

The final scale is incorrectly positioned; it should be shifted to the left so that the trial solution gives the result of 22.5, corresponding to that given in the text.

The chart has been checked by several persons independently, and since I feel it is a useful

one I hope you can make this correction known to your readers.

I would also like to point out that in the formula shown in the chart the final expression under the final radical is an exponent. Because of the way it is printed, it appears instead to the casual observer that this is a multiplier of the term $2/(k+1)$.

EDWARD J. GIBBONS
Mechanical Engineer
New York, N. Y.

▶ *We apologize to Author Gibbons and to our Plant Notebook readers for not catching these drafting-room errors. We suggest that you clip the above portion of the chart* (corrected) *and paste it over the right-hand* (incorrect) *portion of the chart published in June.*—ED.

Ti Impact Is Temporary

Sir:

Regarding your chlorine-caustic review, "Keeping a Dynamic Balance" (May 1956, p. 256), the factors which you mentioned which have helped to keep chlorine and caustic in balance are all true. I suspect that many producers have considered them seriously in their selection of raw materials and processes.

I do not look for the titanium industry to require a great deal of chlorine. If one considers a captive magnesium plant, the chlorine must be used for ore chlorination and the magnesium for reduction of the $TiCl_4$. Thus, the only requirements of each would be the process losses. Though not related, these losses may be quite close to stoichiometric proportions, so the chief requirement would be makeup magnesium chloride.

If the sodium reduction process is used, sodium chloride being of little value could be discarded and the electrolysis performed in noncaptive plants. However, the same balance would apply and the sodium and chlorine requirements might be close to stoichiometric.

Therefore, much of the increase which titanium gives to any of these markets may be quite temporary.

RALPH M. HUNTER
Dow Chemical Co.
Midland, Mich.

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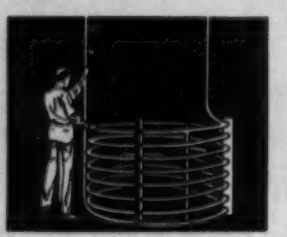

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Meet Your

Raymond E. Vener

LIQUID-GAS CONTACTING (A CHEMICAL ENGINEERING REPORT). PAGE 175

It all began with an exploratory luncheon session early in 1954 at the University Club in Philadelphia. The exact details are clouded by time—except for the excellent bourbon—but the direct result of the session was that the management of the Catalytic Construction Co. agreed in principle that many of the things their company was involved in would be of interest to the readers of *Chemical Engineering*. They would make it known within their organization that publication of technical articles on chemical engineering subjects was a worthwhile company activity. Potential authors were asked to submit subjects.

The list we received several weeks later had at least one title that seemed to be of immediate value. It was an article to be written on Moving-Bed Processes by Dr. R. E. Vener.

We indicated our interest.

Then came the onslaught. Ray Vener telephoned and we arranged for several of our editors to meet with him at the McGraw-Hill Building in New York. Since that first meeting we have never ceased to be amazed at this man who is fired with unbounded energy.

Ray Vener's special talent is his capacity for biting off huge chunks of chemical engineering and presenting it in printed form as practical know-how tempered with mature engineering judgment and the gentle

Authors...

firmness of the inspired engineering educator.

In 1955 he produced a 10-page Feature Report on Solids-Gas Contacting, followed only two months later by a 32-page Report on Moving-Bed Processes.

Only one year later—a minute interval in publishing chronology—he is back with a 32-page job on Liquid-Gas Contacting. He has proposed at least ten other major subjects that he wants to write about.

You have probably concluded that Ray Vener is one of the most talented and energetic chemical engineers in the profession today. You're right.

For the usual details about his education, experience and present employment, refer to p. 178.

Andrew Acrivos

LINEAR PROGRAMMING: HOW DOES IT WORK. PAGE 207.

Andrew Acrivos, born in Athens, Greece, has spent most of his adult life in the U. S. Lured here in 1947 with a scholarship from Syracuse University, he went on—after earning a B.S. in chemical engineering—to the University of Minnesota. Here he received a MS in 1951 and a PhD in 1954 in chemical engineering.

Since 1954 he has been at the University of California, first as an instructor, now as assistant professor. He also recently became a permanent resident of the U.S.

Under Minnesota's N. R. Amundson, Andy developed an

Pretty ridiculous suggestion, isn't it? Yet, many plants are faced with a similar situation when pumps fail. Piping must be removed, fittings and connections dismantled, the driver disconnected . . . all to repair the pump!

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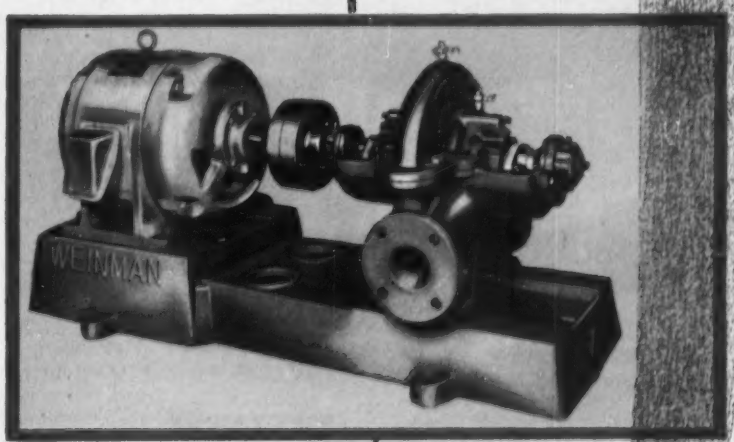

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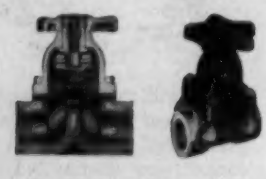

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AUTHORS . . .

interest in the application of mathematical techniques to the solution of problems in chemical engineering, hydrodynamic and control theory.

He looks at techniques such as linear programming as part of a bigger picture. We are seeing the scientific approach applied more and more to problems in many phases of industry and technology—phases where intuition, experience and rule-of-thumb were long accepted as the only possible methods. This scientific approach is greatly stimulating creation of mathematical methods for solving practical industrial problems.

Harry T. Schwan

LINEAR PROGRAMMING: WHAT CAN IT DO? PAGE 211.

Harry T. Schwan is a vice president of Methods Engineering Council—management consultants in Pittsburgh, Pa. A graduate of Oklahoma A&M with degrees in electrical and industrial engineering, he has had extensive experience in both engineering and sales with Westinghouse.

We first met him at a recent meeting of the American Society for Quality Control. We thought his ideas and viewpoints on linear programming would be of particular interest to chemical engineers, and asked him to write an article for us.

After some difficulties were overcome in clearing confidential information (we still aren't permitted to mention the company name) he came up with an article describing the programming of a tar processing plant.

John J. Wilkinson

LINEAR PROGRAMMING: WHAT CAN IT DO? PAGE 211.

John J. Wilkinson, co-author with Harry Schwan on linear programming, is a senior consultant for Methods Engineering Council, currently on assignment in Sweden.

He has an engineering degree from London Univ., England, and worked for English Electric Co. Ltd., first as a staff engineer, then as an assistant to the deputy manager. He has also done some liaison work for English Electric and Westinghouse in Pittsburgh.

In 1953 he decided to go into consulting work in this country, specializing in linear programming and other operations research techniques.

Sy Friedman

HOW TO PICK HEAT FOR PILOT REACTORS. PAGE 217.

In his article this month Sy Friedman draws on some specialized experience to help in setting up a smooth-running pilot unit. As a sales engineer with Industrial Process Engi-

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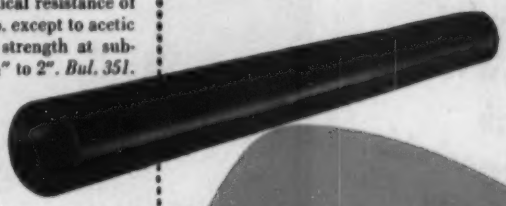

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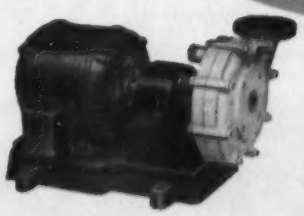

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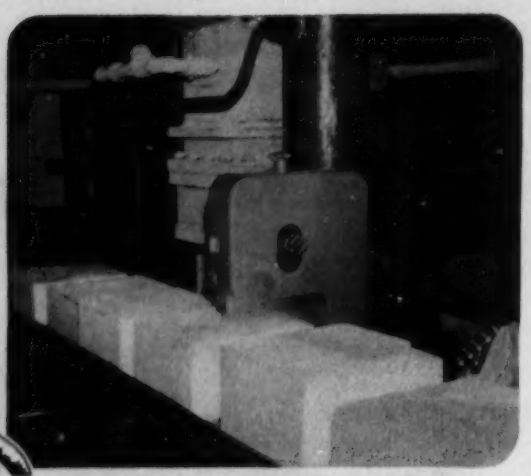

FRICK COMPRESSORS

The Colorado CO_2 Corp. daily produces up to 50 tons of solid carbon dioxide in its 2½-million-dollar plant near Las Animas, Colorado.

The gas, obtained from wells 5 miles away, is condensed, subcooled and solidified in a new Frick-engineered cycle operating at pressures below 250 pounds gage. An ammonia system maintains such low working temperatures that the carbon dioxide can be handled in the two Frick compressors shown at right in the large picture. These are standard Frick machines.

Practically all the mechanical equipment in the plant, including engines, cooling tower, snow machines, shell vessels, compressors, piping, insulation, etc., was furnished and installed by Frick Company. Another example of the COMPLETE engineering service that is yours when you purchase Frick air conditioning, ice making, quick freezing or other refrigerating equipment. Let us quote now on your requirements.

Below: Snow presses, 4-cylinder Frick compressors handling ammonia, and 2-cylinder machines compressing carbon dioxide, at Colorado CO_2 Corp.

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AUTHORS . . .

neers, Newark, N. J., Sy specialized on sales of tailored pilot plants for batch operation. Information in his article is derived directly from experience gained in specifying, building and installing plants for a number of prominent chemical and process companies.

Sy is no narrow one-field specialist. We find him typical of the versatile, clear-thinking chemical engineers of diverse background who are the backbone of the chemical and process industries today. He has built up a broad foundation of experience leading to his present position as a senior engineer with Bechtel Associates, New York.

Following three years in the Chemical Warfare Service—one on combat service with the 91st Chemical Mortar Battalion—Sy entered Pratt Institute in Brooklyn. In 1949, he received his BChE and joined the City of New York, Public Works Dept., to work on waste and sewage treatment. That was the era of foamy heads on aeration tanks resulting from newly available detergents. And Sy found himself in the forefront of search for a cheap defoaming agent.

After two years at the DPW, Sy joined Industrial Process Engineers, Newark, N. J. where he advanced to Project Engineer. Here, he found an abundance of challenging work including a relatively unique, high-pressure fatty-acid hydrogenation plant, a maleic acid anhydride plant, a unit for sodium reduction of fatty acid glyceride which included high-vacuum, multi-component batch distillation of fatty alcohol.

Although busily employed since obtaining his bachelor's degree, Sy has found time to sweat out his MS at Stevens and is now pushing toward his doctorate at NYU.

When we asked Sy about hobbies, he revealed that his favorite is travel, complete with family. He is justly proud of his ability to provide correctly formulated, sterile formula for the baby on the open road. Possibly this ability traces to 12 years in Scouting, though most good scouts seem to have missing this particular specialty in

preparing for the cooking merit badge.

H. Leslie Bullock

WE CAN GET MORE ENGINEERS RIGHT NOW. PAGE 213.

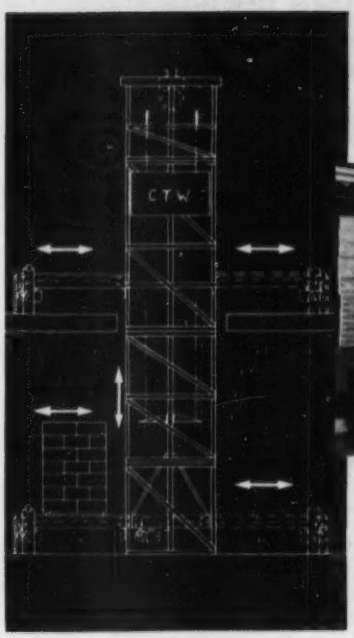
Les Bullock is a fellow who likes being his own boss. He started shooting at an independant consulting career in 1919 as soon as he ended his college days in mechanical engineering at Columbia University. A seven-year hitch with Celanese followed by brief tours as works manager of Keratol, vice-president of British American Industries, Inc., and chief engineer of Technical Sales Corp., prepared him for this goal. Since 1934 Bullock has headed his own consulting firms—Bullock-Smith Associates and, more recently, H. Leslie Bullock.

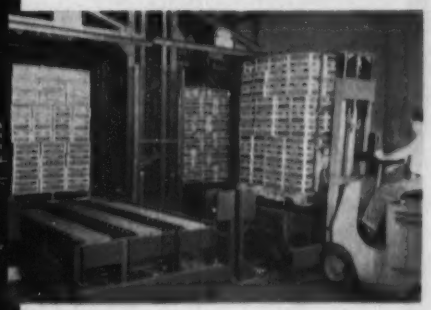
Bullock, a registered professional engineer in the state of New York, has had close contact with a wide range of industrial and process engineering projects over the past 37 years. They include developments in plastic fabrication, coating and embossing of films and fabrics, colloid milling and dry and wet materials separation. He has conducted process and plant surveys, has been called in on patent disputes.

Thus, with many and various doors thrown open to him, he has had a good chance to observe first hand the technical habits of a representative cross-section of working engineers. That is the foundation on which he has built the article we publish this month. In it he points the way to greater engineering output

pallet loads

GOING UP...





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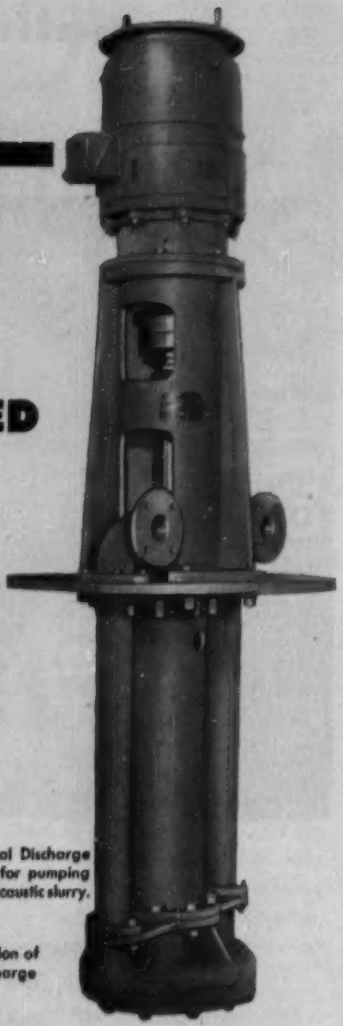

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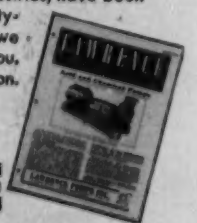

Write for Bulletin 203-7 for complete summary of acid and chemical pump data.

LAWRENCE PUMPS INC.

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AUTHORS . . .

from the existing body of engineers.

Readers will remember many articles by Bullock in recent years, especially his useful and entertaining article "Human Frailties vs. Safety" published last year (see *Chem. Eng.*, Apr. 1955, p. 176). He has lectured to classes at Columbia and MIT on safety, mixing, screening and related subjects. An active member of the ASME, AOA, SPI and NPA, Bullock has also delivered papers before the ACS, AIChE, TAPPI and Wire Association.

Barry Moyerman

BUILD A CAREER IN PATENT LAW. PAGE 238

Barry Moyerman wrote his first article for *Chemical Engineering* only a few years after getting his B.S. in Ch.E. (with first honors) from Philadelphia's Drexel Institute of Technology. His first article (Mar. 1950, p. 98) discussed how to get the right job. In the second (Apr. 1950, p. 124), he told how to make the most of your job.

In both, he drew heavily from his own experiences.

Now a patent attorney with Atlas Powder Co., Mr. Moyerman has again dipped into his bag of experience for his article on choosing and preparing for a career in patent law.

After leaving Drexel, Moyerman first worked as a project engineer with Publicker Industries. Then he started his own business as a representative of process industry equipment manufacturers.

While studying law at Temple University Law School, Barry was also getting practical engineering experience as a pro-

ject engineer with design and construction firms, including Day & Zimmermann Inc. and Catalytic Construction Co. in Philadelphia.

In 1953, after getting his LL.B., Mr. Moyerman joined the Corps of Examiners of the U. S. Patent Office. His duties involved examining applications in the field of distillation.

In addition to being a patent attorney, Barry is a registered professional engineer in Pennsylvania. He's a member of Tau Beta Pi, the AIChE, the Engineers' Club of Philadelphia and the Pennsylvania Society of Professional Engineers.

V. B. Volkening

METHOD FOR FINDING COMPARABLE PAINT COATS. PAGE 248.

Dow Chemical's V. B. Volkening, together with John T. Wilson (also of Dow), constructed the paint cost nomograph appearing in the Corrosion Forum Dept. of this issue. This nomograph puts paint costs on a comparable basis.

Volkening has been involved with corrosion and materials of construction since 1945. At present, he is group leader in the materials evaluation laboratory of the chemical engineering department at Freeport, Tex. His earlier positions with Dow have been in research, production and the analytical lab.

Before joining Dow in 1940, he was associated with Duval Texas Sulphur Co. (now Duval Sulphur & Potash Co.), Orchard, Tex. for about three years. He is a chemical engineering graduate of the University of Texas.

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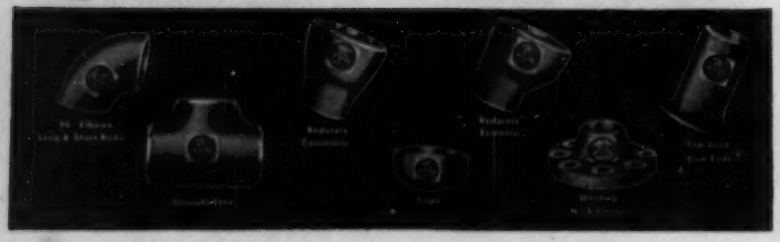

AUTHORS . . .

Chlorinated Seawater at Various Velocities" (*Corrosion*, April 1950), "Wood in a Gulf Coast Chemical Plant" *Forest Products Research Journal*, May 1953), and "Paint vs. Corrosion —Some Aspects of the Problem in the Gulf Coast Area" (*Corrosion*, Feb. 1954) are among Volkening's publications. He is a member of the ACS, NACE, American Wood Preservers Assn., and the Coatings Society of the Houston Area.

Mr. Volkening devotes his extra-curricular time to his family (including four children), to movie photography, and to spectator sports—and serves as a director of the Brazosport chamber of commerce.

John T. Wilson

METHOD FOR FINDING COMPARABLE PAINT COSTS. PAGE 248.

As a co-author with V. B. Volkening, John Wilson helped prepare the comparable paint cost nomograph in this month's Corrosion Forum. He is very much concerned with costs; his present position with Dow Chemical at Freeport, Tex., is as research and development engineer in fields of economic evaluation, cost estimation, statistical analysis and correlation of experimental data. Before joining Dow in 1944, Wilson was with Columbia-Southern at Barberton, Ohio, and with Midcontinent Petroleum at Tulsa, Okla.

He has a master's degree in chemical engineering (Ohio State, 1938), and is a member of the AIChE. His hobbies include his family (including two children), chess, bowling, philately and spectator sports.

THIS MONTH'S

Technical Bookshelf

EDITED BY R. K. GITLIN

Industrial Planning

ECONOMIC GEOGRAPHY OF INDUSTRIAL MATERIALS. Edited by A. S. Carlson. Reinhold Publishing Corp., New York. 494 pages. $12.50.

Economic geography and chemical engineering have a similar heritage. Both are offsprings of the mating of two established professions — economic geography, from economic and geographical considerations; chemical engineering, from chemistry and mechanical engineering. Both solve problems that neither sets of parents could alone.

But unlike chemical engineering which has already gained its identity with the growing importance of the chemical process industries, economic geography has enjoyed, at best, only a Cinderella relationship with other human sciences.

However, with the increasingly urgent import of problems posed by modern industrial growth, it's likely that economic geography will also exchange its kitchen residence for a place in the college curricula.

▶ **For Industrial Planning**—Although not primarily intended for that purpose, Mr. Carlson's book could serve as an initial handbook for such a course.

Concerned today with industrial growth problems, in the absence of formally educated economic geographers, are a conglommerate of variously trained people. And they function under diverse categories — industrial management, industrial economics, market research, labor relations, etc.

It is for them that this book is intended. Used properly, it might become a sort of handbook for industrial planning.

Editor Carlson, professor of geography at Dartsmouth, offers a compilation of twenty key industries by 27 outstanding author-experts. A single chapter is devoted to each industry and each is appropriately listed under one of the following major headings: Fuel and power, products from minerals, natural and synthetic products, agricultural and food products.

▶ **Keynote in Two Chapters** — The industry listing is remarkably complete, with a wealth of information packed into each chapter. And yet it is the first two chapters (not concerned with any particular industry), which keynote the purpose of the book. Without them, it would be merely a general, if interesting, industrial survey.

Written by Geographer Carlson and Economist D. P. Locklin (University of Illinois), these introductory chapters provide the tools with which to give practical applicability to the storehouse of information contained in the remaining chapters.

Carlson's "Populations and Their Resources" draws a total picture of the character of world industry. First, he locates populations in three major areas—the Orient, Europe and western USSR; eastern Canada and U. S. Then he points out the reasons for these concentrations—habitable landforms, favorable climate, sufficient rainfall, etc.

Finally he ties in the reasons for the prosperous industrial activity in the Atlantic basin in particular—accessibility to raw materials, markets and exchange of goods, etc.

Locklin's chapter, "Transportation," draws a similar overall picture. This time the industrial significance of the five modes of transport—rail, water, pipeline, air and highway—are broadly, but penetratingly, analyzed.

In effect, these two chapters are concise courses in economic geography. They demonstrate how economic and geographical considerations predetermine the essential nature of industry. And they infer the prognostic powers of these considerations.

▶ **Focuses on Industry Growth** —With the lessons mastered, the book becomes a powerful tool for industrial planning. Each chapter details the considerations of

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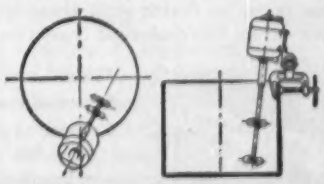

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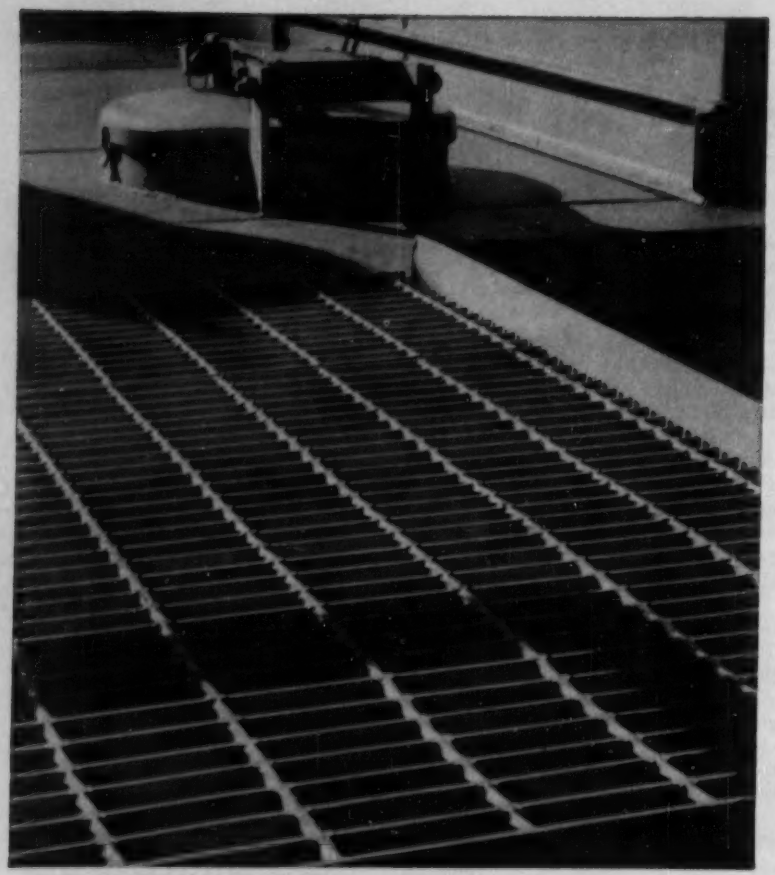

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the particular industry under discussion. Each is loaded with charts, maps, tables. And the data are excellently up-to-date, often derived from 1955 source materials.

Industries' phenomenally accelerated growth in the past decade, the continually diminishing frame in which this growth can occur and the necessity of artificially directing this growth in the face of the total destructivity of atomic war are conditions that sharpen the need for specialized understanding of economic geographical factors.

Carlson's book focuses attention on these factors. And he gives to them the formality of a human science and the opportunity to study them as such.—TPF

Nothing Like It

CHEMICAL PROCESS INDUSTRIES, 2nd edition. By R. Norris Shreve. McGraw-Hill Book Co., New York. 1,004 pages. $11.50.

As soon as Shreve's new second edition landed on my desk, I automatically reached up for a dog-eared copy of the first edition and turned to the title page to check the publication date. There it was—1945.

Eleven years is a long time—and particularly long in the fast-moving chemical process industries. Professor Shreve has had a lot of catching up to do in revising his book. He's done a commendable job.

▶ **Valuable Flow Charts** — This latest volume presents a "cross section of the manufacturing procedures employed by modern chemical industries, largely separated into their unit chemical processes and unit physical operations through the use of flow charts."

These flow charts are an important part of the book. The great majority of them are admirable—compact and complete. Practically every one of the 39 chapters — starting with coal chemicals; through industrial carbon, glass, nitrogen, synthetic fibers; ending with organic chemicals not otherwise classified—contains several excellent examples.

Shreve has tried to include

some economics, e.g., costs, product consumption, energy and power requirements in his process descriptions, but without complete success. This information is hard to come by.

▶ **Follows Broad Approach**—He emphasizes broad process principles not details. Important temperatures and pressures are here. But if you're looking for something like the discharge pressure of the recirculating pump on No. 3 distillation column, chances are you won't find it.

For the student, this treatment is adequate "as a link between many of his basic scientific and technical courses, on the one hand, and their application, on the other."

For the practicing engineer, this broad approach isn't nearly as useful as specific intimate process details. But the book can help him with information on industries outside his field of specialization. It provides extensive references to detailed articles.

▶ **Some Material Already Outdated**—Every reviewer is expected to find some faults in the book he reviews and I won't attempt to break away from this pattern.

One fact (perhaps not so surprising) came to light in leafing through the pages. Shreve has culled the literature through January 1954—and in some instances his process descriptions are already out of date.

The nitrogen industry—particularly ammonia synthesis—has changed radically since 1954. Looking to his next revision, he should include material on the highly important Texaco partial oxidation process for preparing ammonia synthesis gas as well as requirements for tonnage oxygen units in modern ammonia plants. The section on synthesis gas for ammonia is pitifully inadequate.

There are no process descriptions in the section on mixed fertilizers. Important new techniques for making mixed, granular fertilizers are completely neglected.

However the treatment of the perfume and flavoring industry is excellent—complete and well written.

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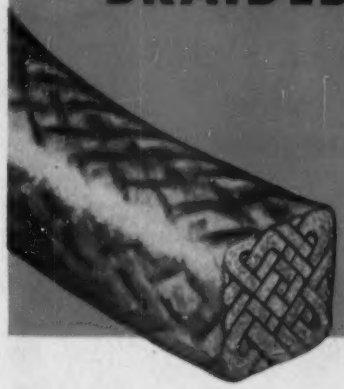

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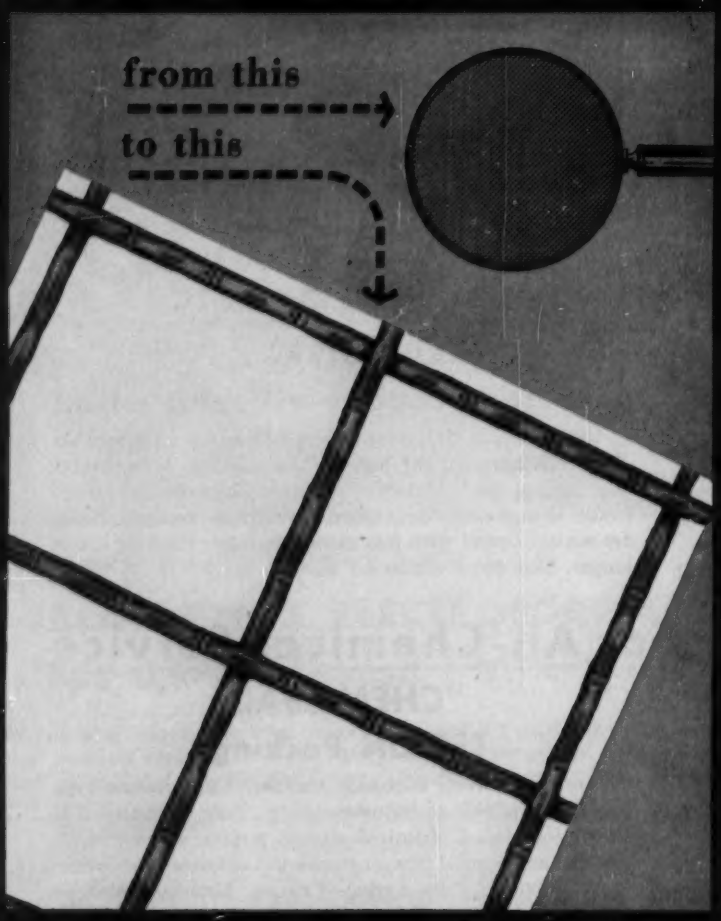

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One other comment: I don't think any author should devote an 8-page chapter to merely defining his book's objectives. Three pages would be enough.

But these are really piddling criticisms. There is no book that compares with Shreve. For anyone working in the chemical process industries, it's a must for the reference shelf.—RBN

Briefly Noted

METAL STATISTICS 1956. 844 *pages.* $350. *Edited by N. J. Langer. American Metal Market,* 18 *Cliff St., New York* 38, *N. Y.* 49th annual edition covering production, deliveries, stocks, consumption, imports-exports, prices of ferrous and non-ferrous metals. Includes alphabetical listing of metal and chemical products sold by book's advertisers.

ANALYTICAL CONTROL FOR AMMONIA SYNTHESIS. 446 *pages.* $4.25. *Compiled by J. R. Hall, G. D. Barnes and E. D. Frederick. Tennessee Valley Authority Office of Chemical Engineering, Wilson Dam, Ala.* Covers in detail analytical procedures used in TVA's synthetic ammonia plant. Some procedures originated in TVA labs, most are modifications of standard, established analytical methods.

1956 HEAT TRANSFER AND FLUID MECHANICS INSTITUTE. 278 *pages.* $5.75. *Stanford University Press, Stanford, Calif.* Preprints of 16 of the 17 papers presented at Stanford University, June 21-23.

PROCEEDINGS OF THE SECOND ANNUAL COMPUTER APPLICATIONS SYMPOSIUM. 108 *pages.* $3. *Armour Research Foundation, CAS:2, Technology Center, Chicago* 16, *Ill.* Covers applications of computers and data processing machines to business and management problems as well as to engineering and research problems.

ORGANIC COMPOUNDS OF POLYVALENT IODINE. 70 *pages. By F. M. Beringer and E. M. Gindler. Chilean Iodine Educational Bureau, Inc.,* 120 *Broadway, New York* 5, *N. Y.* Constitutes Vol. 3, No. 3 of *Iodine Abstracts and Reviews.* Tabular listing of organic derivatives of polyvalent iodine under four basic groups—iodoso compounds, iodoxy compounds, iodonium salts and iodyl salts. Includes structure, name and numbering of parent com-

pounds; substituted derivatives; physical properties, melting points, references to original literature.

PROCEEDINGS OF THE GAS DYNAMICS SYMPOSIUM — AEROTHERMOCHEMISTRY. 250 *pages.* $4. *By M. Summerfield, et al. Gas Dynamics Symposium, Technological Institute Library, Northwestern University, Evanston, Ill.* 25 research papers given at symposium (August, 1955) sponsored by American Rocket Society and Northwestern University with the cooperation of the Air Research and Development Command (U.S.A.F.) Subjects covered include turbulent combustion, flame stabilization, detonation, thermodynamics, laminar flames and combustion of condensed phases.

STANDARD CLASSIFICATION AND TERMINOLOGY FOR POWER ACTUATED VALVES. 12 *pages. Fluid Controls Institute, Box* 191, *Decatur, Ill.* Results of project undertaken by Fluid Controls Institute (formerly National Steam Specialty Club) to provide framework of standard terms for everyday use of operating engineers, instrument engineers and mechanics.

INDUSTRIAL RESEARCH LABORATORIES OF THE UNITED STATES (1956). 10*th ed.* 560 *pages.* $10. *National Academy of Sciences, National Research Council,* 2101 *Constitution Ave., Washington* 25, *D. C.* Includes information on over 4,000 laboratories. Entry for each organization shows names and locations of its labs; principal research executives; number of professional, technical and administrative employees in each lab; kinds of research in which they're engaged. Alphabetical code shows types of research services performed at each lab. Index of research activities includes over 1,000 major subject headings.

POLYURETHANES — A VERSATILE SYNTHETIC FOR A DYNAMIC ERA. 115 *pages.* $10. *By A. C. Beutel, et al. Polyurethane Associates, P. O. Box* 98, *Cambridge* 38, *Mass.* Comprehensive report covering all aspects of polyurethanes — development and progress; market potentials; descriptions of manufacturing procedures; estimates of required capitalization; projections of costs, selling prices, profitability. Report was written as a group project by nine second-year students at Harvard Graduate

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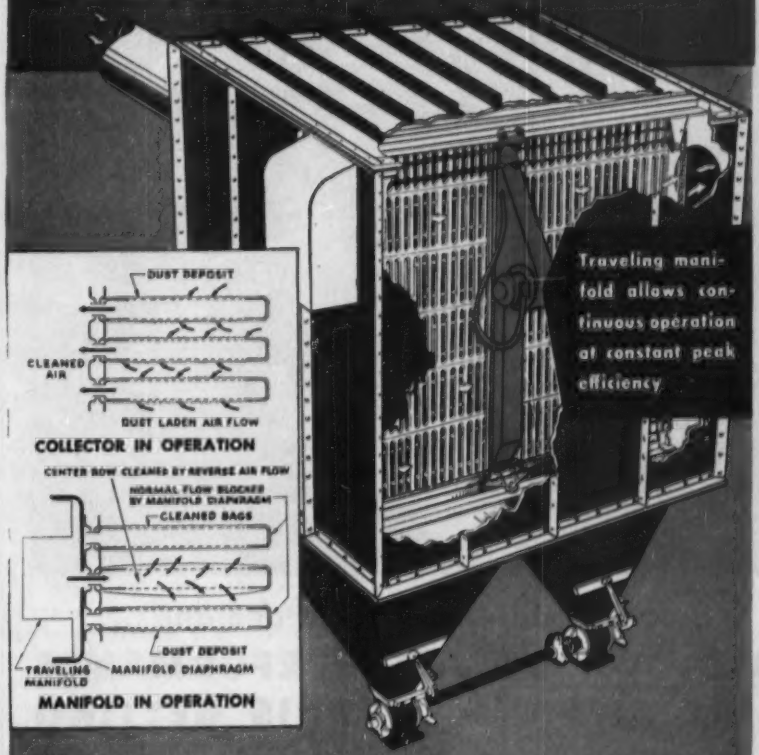

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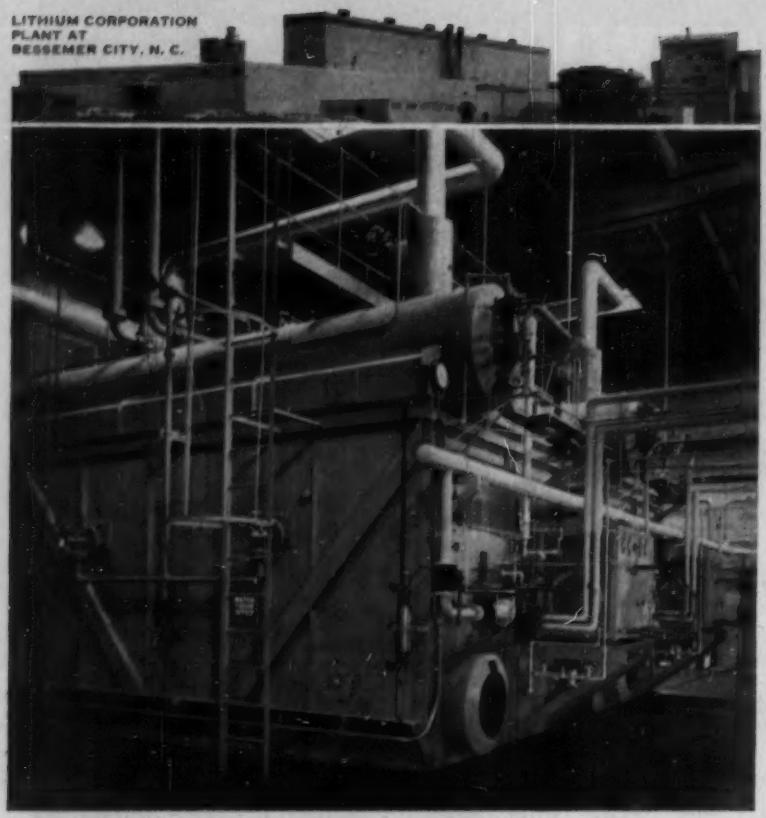

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More New Books

ADVANCES IN ENZYMOLOGY. Vol. 17. Edited by F. F. Nord. Interscience. $11.

COMPUTERS—THEIR OPERATION AND APPLICATIONS. By E. C. Berkeley and L. Wainwright. Reinhold. $8.

ELEMENTARY NUCLEAR THEORY. 2nd ed. By H. A. Bethe and P. Morrison. Wiley. $6.25.

HOW TO FIND A BUYER FOR YOUR INVENTION. By V. D. Angerman. Science and Mechanics Publishing. $2.95.

ION EXCHANGE TECHNOLOGY. Edited by F. C. Nachod and J. Schubert. Academic Press. $15.

ORGANIC CHEMISTRY. 3rd ed. By L. F. Fieser and M. Fieser. Reinhold. $10.

PEACEFUL USES OF ATOMIC ENERGY. Vol. 1—THE WORLD'S REQUIREMENTS FOR ENERGY; THE ROLE OF NUCLEAR POWER. $80. Vol 7—NUCLEAR CHEMISTRY AND THE EFFECTS OF IRRADIATION. $10. Vol. 8—PRODUCTION TECHNOLOGY OF THE MATERIALS USED FOR NUCLEAR ENERGY. $10. Vol. 9—REACTOR TECHNOLOGY AND CHEMICAL PROCESSING. $10. Columbia University Press.

PHASE DIAGRAMS FOR CERAMISTS. By E. M. Levin, H. F. McMurdie and F. P. Hall. American Ceramic Society. $10.

POLYESTERS AND THEIR APPLICATIONS. By Bjorksten Research Laboratories. Reinhold. $10.

PRECISION ELECTRICAL MEASUREMENTS. Philosophical Library. $12.

REACTOR SHIELDING DESIGN MANUAL. Edited by T. Rockwell III. McGraw-Hill. $6. Van Nostrand. $6.

SPECIAL FUNCTIONS OF MATHEMATICAL PHYSICS AND CHEMISTRY. By I. N. Sneddon. Interscience. $1.75.

SURVEYING INSTRUMENTS AND METHODS. 2nd ed. By P. Kissam. McGraw-Hill. $5.75.

SYNTHETIC ION-EXCHANGERS—RECENT DEVELOPMENTS IN THEORY AND APPLICATION. By G. H. Osborn. Macmillian. $6.

THIS MONTH'S

Firms in the News

EDITED BY F. ARNE

New Companies

Quality Tools Corp., Roosevelt, L. I., N. Y., has been set up to manufacture models and molds for vacuum forming of plastic sheet materials.

Francinite Co. has been organized to develop a light plastics industry in Honolulu, Hawaii. The firm will make products from a combination of waste materials like wood chips, sawdust, bagasse and coconut fronds and husks.

Schock Gusmer & Co. (Australasia) Pty. Ltd. has been formed to manufacture brewhouse equipment for Australian and New Zealand markets. It is jointly owned by Pfaudler Co., Rochester, N. Y., and Mauri Bros. & Thomson Ltd. of Sidney, Australia.

Swanson Wright & Co. Engineers Ltd., consulting engineers, has been formed in Vancouver, B. C.

New England Nuclear Corp., Boston, has been formed to manufacture labeled compounds, reference sources and radioactivity devices.

Sharples Chemical and Industrial Ltd., Nassau, Bahamas, has been formed to act as an international organization to offer the processes, equipment and design facilities of Chemical and Industrial Corp. of Cincinnati.

Union Bag-Camp Paper Corp. has been formed through a merger of Union Bag & Paper Corp., New York, and Camp Mfg. Co., Franklin, Va.

United States Borax & Chemical Corp. has been formed as a result of a merger between Pacific Coast Borax Co. and United States Potash Co.

Ramascar, Inc., has been organized as a joint venture of Carboline Co., St. Louis, Mo., and Oronzio De Nora, Milan, Italy, to import Carboline's maintenance coatings, tank linings and floor coatings to Europe.

Uranium Institute of America with headquarters in Washington, D. C., has been formed to serve as a medium between the public and the privately-owned uranium industry.

Tyron, Inc., Cambridge, Mass., has been organized to undertake industrial research, development and manufacture in the fields of mechanical and chemical processes, including heat transfer, combustion, fluid mechanics, corrosion and materials of construction.

SD Plants, Inc. has been formed by Scientific Design Co., New York, as a wholly-owned subsidiary for the construction of industrial plants in the chemical field.

New Facilities

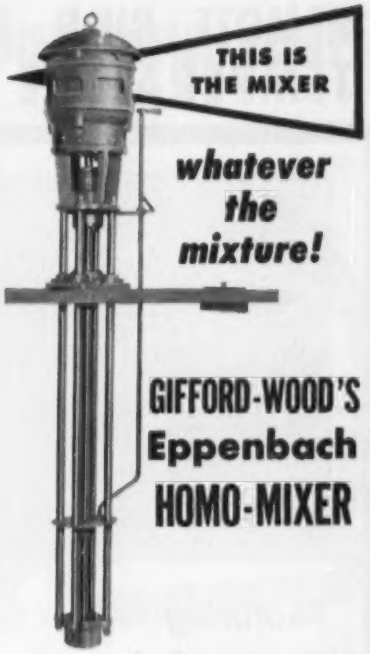
Kerr-McGee Oil Industries, Inc., has acquired a 20,000-bbl./day refinery in Cushing, Okla., from General American Oil Co.

Logo, Inc., Chicago, has completed an expansion which more than doubles its tank farm, research and metallizing coatings facilities.

Carborundum Corp. will boost capacity for production of silicon carbide 16% this year at its Vancouver, Wash., plant with a $300,000 expansion.

Acetafil S.A. of Havana will complete Cuba's first acetate yarns and fibers plant the latter part of 1957. It will produce 6 million lb./yr.

Jefferson Lake Sulphur Co. of New Orleans has contracted with Pacific Petroleums Ltd. of Calgary for construction of $1.8 million sulfur manu-



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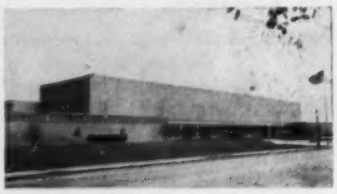
facturing plant near Fort St. John, B. C. The unit will be located near an $18-million absorption plant to be built by Pacific Petroleums.



Continental Can Co. has opened a $7-million laboratory for research and engineering in Chicago.

Allied Chemical & Dye Corp. plans expansion of production of Plaskon polyester and liquid phenolic resins at its Barrett Div.'s Toledo plant.

Chemstrand Ltd. plans to build a 10-million-lb./yr. Acrilan acrylic fiber plant in Great Britain.

Aluminum Co. of America has plans for spending up to $600 million on plant expansion in the next five years.

Hancock Chemical Co. will build a $1.5-million 130-ton/day sulfur recovery plant in Wilmington, Calif.

Steel Co. of Wales is building two oxygen plants, with a combined capacity of 300 tons/day and at a combined cost of $2.8 million, at its Margam Steel Works.

Hercules Powder Co. has started operating a new petrochemical unit at its Gibbstown, N. J., plant to produce cumene under license from Universal Oil Products Co.

Lederle Laboratories plans a $2.1-million laboratory-type plant at Gasport, Hants., England, to make antibiotics based on aureomycin.

Economics Laboratory, manufacturers of cleaning compounds for home and commercial use, is building a $750,000 plant in Chicago.

Union Oil and Gas Corp. will build a $4-million plant near Eunice, La., for processing

300 million cu. ft./day of natural gas from which it will extract liquid hydrocarbons.

American Can Co. will spend $27 million in the next two years installing new equipment and plants to process its own steel.

Electro Metallurgical Co. has established a metallurgical service division to serve customers in the iron, steel and non-ferrous industries.

Lake Asbestos of Quebec, Ltd., will complete a $9-million asbestos ore milling plant early in 1958.

Gulf Research & Development Co. is spending $1.5 million on new buildings in Harmarville, Pa., to house expanded research on the recovery of petroleum from oil fields.

Stanford University is spending $45,000 on additional space to accommodate enlargement of what is already the world's biggest linear electron accelerator.

Eli Lilly & Co. will increase its chemical capacity by 50% with a $3.4-million plant to be completed near Lafayette, Ind., late in 1957.

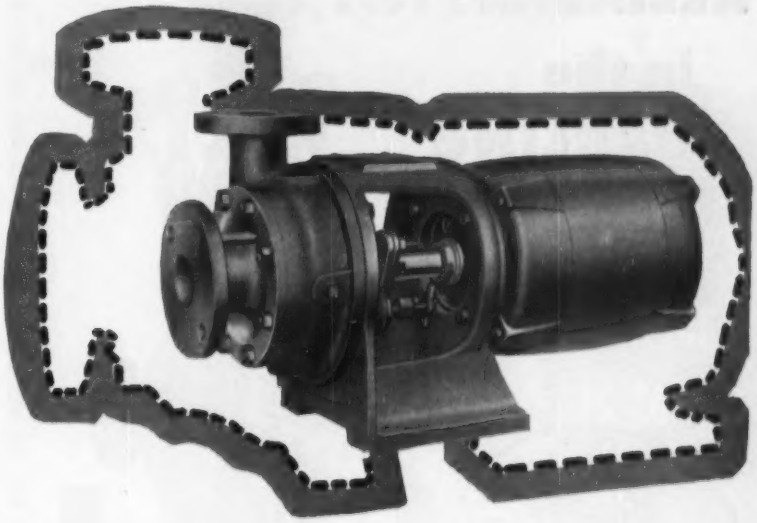
Reynolds Metals Co. has started installation of a $160,000 caustic soda recovery plant at its Longview, Wash., aluminum smelter to reprocess waste lime sludge.

Guardian Chemical Corp., producer of disinfectant chemicals, has started production in its new $100,000 Long Island City, N. Y., plant.

American Brass Co. has started construction of a $25-million integrated aluminum mill in Terre Haute, Ind. Production is expected by the third quarter of 1957.

Republic Steel Corp., Cleveland, has acquired half interest in Cramet, Inc., the titanium sponge producing subsidiary of Crane Co. Cramet has a

You can cut pumping costs



by doing the job with a smaller Ingersoll-Rand

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By reducing original cost. Many plant operators say yes, because liquid handling operations can generally be done by I-R Motorpumps of lower horsepower than other pumps.

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Williamsport 3, Pa.
Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

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DARLING
VALVES

FIRMS . . .

year-old plant at Chattanooga, Tenn., which eventually will have a 6,000-ton/yr. capacity. Republic is also rebuilding a coke oven battery at its Cleveland works, increasing capacity 25% to 1,000 tons/day of coke.

Copolymer Rubber & Chemical Corp. has announced new plans for major expansion of its Baton Rouge plant (including a butadiene unit) which will increase manufacturing facilities by 30%.

Monsanto Canada Ltd. is completing construction of a new synthetic resin plant at Clover Bar, Alberta.

Michigan State University has announced plans for a new $13-million engineering building.

Compania Cubana Primadera S.A. of Cuba has borrowed $1.5 million from the Export-Import Bank to build a plant to make hardboard out of sugar cane bagasse.

Jordan government plans a plant to extract 70,000 tons/yr. of potassium chloride from the Dead Sea.

Pennsylvania Salt Mfg. Co. is completing an agricultural chemical processing plant and distribution center at Navojoa, Sonora, in Mexico. Also, the company has just opened a new fluorspar mine in Crittenden County, Ky.

General Electric Co. has organized a new laboratory in Syracuse, N. Y., to concentrate on the industrial electronics field. A 5-yr., $23-million expansion program has also been announced for the company's Lynn, Mass., generator and gear department.

Ferro-Co Corp. is building a new plant in Maspeth, L. I., N. Y., to make laminated fiberglass products.

Tenney Engineering, Inc., Union, N. J., has just established a separate engineer-

ing section to offer consultation service on the design of new environmental test chambers and the modification of existing equipment.

Nuclear Corp. of America, New York, has acquired Isotope Specialties Co., Burbank, Calif., producer of tagged chemicals.

Chemway Corp. has started construction of multi-million dollar executive and administrative offices in Mountain View, N. J.

Kerr-McGee Oil Industries, Inc., has opened a new Denver office combining mining and ore processing headquarters and a metallurgical research laboratory.

Socony Mobil Co. has put on stream a 20,000-bbl./day catalytic reformer at its Paulsboro, N. J., refinery.

Bowater Corp., London, England, has started building a new sulfate pulp mill near Rockhill, S. C.

Goshen Rubber Co., Goshen, Ind., is completing a $500,000 modernizing and enlargement program.

Koppers Co. has bought a 176-acre tract of land near Monroeville, Pa., as the site for a new multi-million dollar research center.

Davison Chemical Co. has completed a $1.2-million improvement and expansion program affecting three of its fertilizer plants at Alliance, Ohio; Perry, Iowa; and Curtis Bay, Md.

McNeil Machine & Engineering Co. has acquired the Lincoln Engineering Co., St. Louis designer and manufacturer of lubricating equipment.

American Research Corp., manufacturer of environmental test equipment, is building a new plant in Farmington, Conn.

Duncan, Dieckman, Duncan Mining Co., St. Louis, is

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There's an element of abrasion, too, in addition to the heat and some corrosion. It's a 3-way problem which our metallurgists recognize and understand. Duraloy Flights used in many kilns are taking care of these three requirements very satisfactorily.

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(Chemical Engineering, Dec., 1955)

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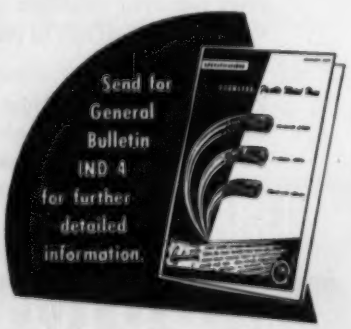


PACKLESS

METAL HOSE, INC., 31-51 Winthrop Ave., New Rochelle, N. Y.

FIRMS . . .

about to add a leaching plant to its present facilities for the production of manganese sulfate and manganese oxide at Mena, Ark.

Westinghouse Air Brake Co. has started a $5.5-million engineering and research program for the Milwaukee plant of its Le Roi Div.

Electric Storage Battery Co., Philadelphia, has formed a new division to conduct experimental work with batteries containing both silver-zinc and nickel-cadmium active materials in alkaline electrolyte.

Shell Chemical Co. Ltd. has completed a $420,00 expansion of its Woodstock agricultural research center at Sittingbourne, England.

Minerals & Chemicals Corp. of America, Menlo Park, N. J., has initiated a new service for in-plant evaluation of products, production and costs for manufacturers who use adhesives.

National Starch Products Inc. has established a Miami office for its resin division.

American Potash & Chemical Corp. has established a Washington, D. C., office.

Richfield Oil Corp. is considering the construction of a $50-million refinery in northwest Washington state.

Iraq Government Oil Refineries Administration intends to increase production at its Dora refinery by 10,000 bbl./day to 40,000.

Archer-Daniels-Midland Co. has opened sales offices in Houston.

Dragoco, Inc., West German producer of aromatic chemicals, has established a U.S. division with headquarters in New York.

Precision Rubbers, Ltd., Bagworth, England, has signed a 10-yr. contract with Connecticut Hard Rubber Co.,

New Haven, Conn., under which the latter will furnish technical information on the production of specialized silicone rubber and fluorocarban plastic for aircraft parts.

Wilrich Petroleums Ltd. has put a $2-million refinery on stream at Dawson Creek, B. C.

Thomas De La Rue & Co. Ltd., Tynemouth, England, plans to set up a laminated plastics plant in Sydney, Australia, at a cost of $2.8 million.

New Names

F. J. Stokes Machine Co. has changed its name to F. J. Stokes Corp. because it is more in keeping with the company's output of varied production and processing equipment.

Detrex Corp., Detroit, which recently announced agreement to buy all outstanding capital stock in Hooker-Dextrex, Inc., has changed its name to Detrex Chemical Industries, Inc.

Firestone Tire & Rubber Co. has selected a brand name of its own for the general purpose rubber it manufactures. The product will be called FR-S, replacing the GR-S name used when synthetic rubber plants were government owned.

Continental Can Co. has acquired a line of glass containers through a merger with Hazel-Atlas Glass Co.

New Lines

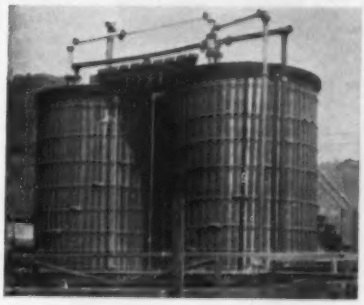
Cowles Chemical Co. can now make fatty acids to customer specifications because of newly-installed fatty acid splitting equipment at its Skaneateles Falls, N. Y., plant.

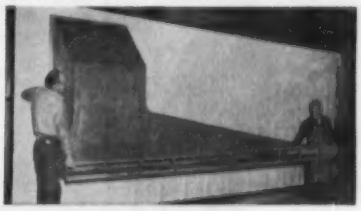
Continental Coatings Corp. has been granted exclusive license to the "Flame Ceramics" process developed by the Armour Research Foundation. Heat-, abraison- and chemical-resistant coatings are produced by spraying

HAVEG® News

Wherever CORROSION RESISTANCE Is a Factor

HAVEG PLASTIC TANKS MEET EVERY SERVICE REQUIREMENT





HAVEG STORAGE TANKS, REACTORS, COLUMNS, TOWERS, PLATING TANKS, FILTERS and similar equipment are now manufactured in every type and size, rectangular and cylindrical—in a wide range of Haveg grades, combined with selected chemically inert materials to provide exceptional resistance to corrosive acids, hypochlorites, salts, alkalies and various oxidizing agents.

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HAVEG TANKS are economical to install . . . easy to maintain. **NEW POLYESTER GLASS** constructions, for example, *cost considerably less installed than lead or rubber-lined, stainless or even mild steel types in many instances* . . . offer bonus savings in reduced steel for support because of their extreme light weight! Haveg plastic tanks require no painting or costly maintenance . . . can be readily field repaired where necessary.

Whether yours is a new or replacement installation, investigate the advantages of Haveg corrosion resistant plastic tanks and process equipment for your process operations. Write for Bulletin C-13.

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Haveg fume duct, hoods, stacks, fans and fittings in the Haveg reinforced plastic best suited to handle the corrosive fumes and gases at your plant, offer the most practical and economical system possible wherever fume removal is an operational requirement.

Engineered for use up to 350°F., Haveg fume removal units are light in weight for easy, low cost installation, or for heavy duty service where required. Hoods are readily molded and joined in varying shapes and sizes . . . stacks up to 12 foot diameter and over 200′ high can be flanged for quick assembly—or resin-welded as a single unit! Complete fittings are available from stock, or can be custom-fabricated to your specific requirements. A Haveg engineer will be glad to assist you in planning a complete system for your plant . . . or selecting Haveg units to replace deteriorated apparatus in your present system.

You can make anything in Haveg that you can make from metal. Haveg is tough, durable, machineable, easily and quickly altered or repaired in the field.

Haveg Bulletins F-7 and C-13 give detailed data on the complete line of corrosion resistant Haveg process equipment and resin cements to solve *every* corrosion problem. Write for your copies at no obligation.

H-604

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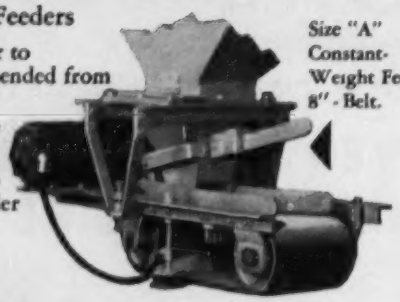
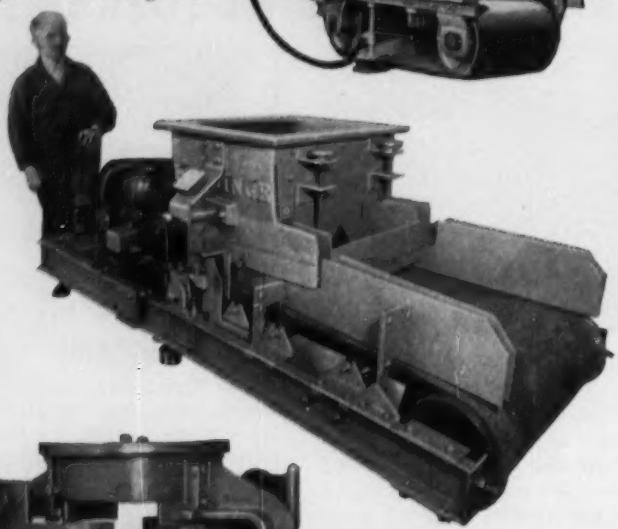
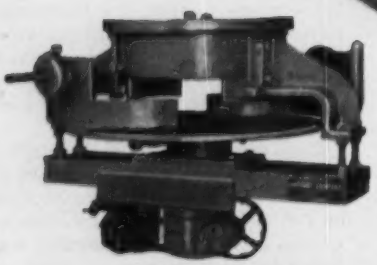


Size "A" Constant-Weight Feeder, 8" - Belt.

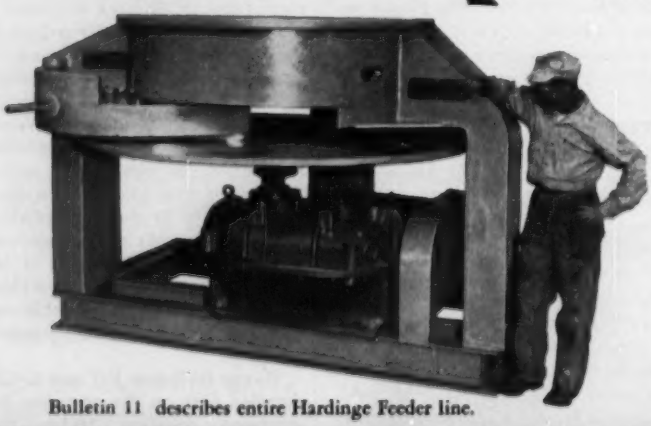




Size "D" Constant-Weight Feeder, 36" - Belt.

30" Disc Feeder

84" Disc Feeder



Bulletin 11 describes entire Hardinge Feeder line.

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FIRMS . . .

non-metallic powders (generally crystalline oxides or oxide mixtures) through a flame gun on an otherwise unheated surface.

G. S. Ziegler & Co., New York, has entered the underground pipe field with a Gilsonite product called Insul-Ite.

New Locations

General Ultrasonics Co., Hartford, Conn., manufacturer of ultrasonic processing equipment for cleaning, degreasing, pickling and electroplating has moved to a new and larger plant at 67 Mulberry St.

Misco Fabricators, Inc., Detroit, designers and builders of heat resisting alloy and stainless steel equipment, has moved to 3564 Toledo Ave.

Metal & Thermit Corp. has moved its general office to Rahway, N. J. Executive offices remain at 100 Park Ave., New York.

Air Reduction Co. has moved its executive offices to 150 East 42nd St., New York.

Trio Laboratories, Inc., has moved its plant and offices to 4025 Merrick Rd., Seaford, L. I., N. Y.

Industrial Development Corp. of South Africa, Ltd., has moved to the Corporation Bldg., Commissioner and Rissik Sts., Johannesburg.

Celanese Corp. of America has moved its European office, formerly in Duseldorf, Germany, to 17, Rue Neuve du Molard, Geneva, Switzerland.

M. W. Kellogg Co. has moved the Chicago sales offices of its chemical manufacturing division and chimney division to 221 North LaSalle St.

American Iron and Steel Institute has moved to 150 East 42nd St., New York.

Stauffer Chemical has transferred its southeastern regional sales headquarters to 2009 Orient Rd., Tampa, Fla.

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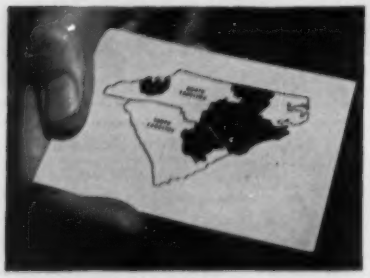

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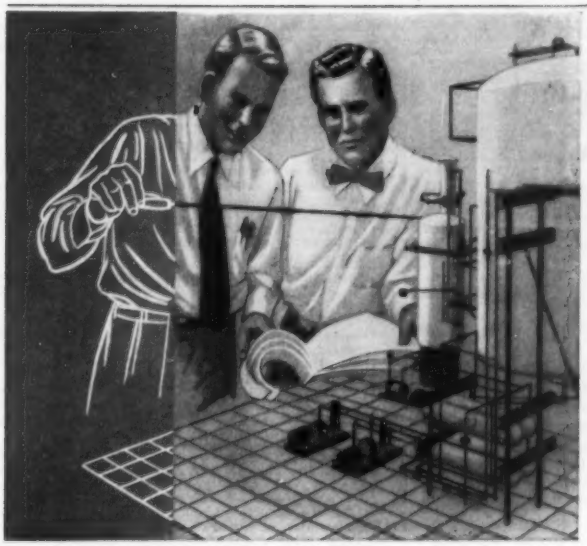


Engineers—

Ask P & G About Your Real Future

Engineering models like the one above play a vital part in providing Procter & Gamble engineers with a three-dimensional look at the future.

Naturally you can't build a scale model of *your own future*, but you can plan closely a *future* that will combine your technical skills with the greatest professional and personal opportunities. And in its Cincinnati engineering staffs for domestic and overseas activities P & G is ready to help you realize your engineering career plans in the following fields:

• Automatic Machinery • Chemical Process Equipment • Power Generation and Distribution
• Instrumentation and Control • Building Design • Metallurgy
• Construction Management

Procter & Gamble offers you:

- An immediate, challenging engineering role with one of the nation's leading manufacturers of soaps, detergents, drug products, food products and chemical specialties.
- A program of career development custom-tailored for your interests—whether they are of a technical, administrative or managerial nature.
- The opportunity to progress rapidly with a company that has doubled its business volume every 10 years since 1900. Over half of the company's total present business in household products is in brands not on the market 10 years ago. P & G has been cited by the American Institute of Management consistently as one of the nation's best-managed companies.

IF . . .

Your background qualifies you for any of the above opportunities . .

You were graduated with an engineering degree within the last 10 years . . .

DISCOVER YOUR REAL FUTURE
IN ENGINEERING AT P & G
BY FILLING OUT AND MAILING
THE COUPON AT THE RIGHT

Mr. J. E. Gale
Engineering Division
Procter & Gamble
Cincinnati 17, Ohio

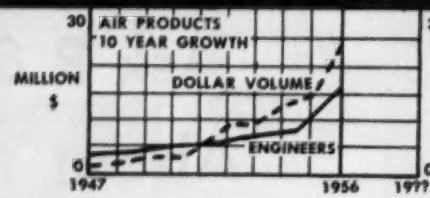
Dear Mr. Gale:

I would like to know more about my *real future* in engineering with Procter & Gamble. Please send me your four-color brochure "Future for Engineers and Chemists" and a personal data sheet.

Name_____

Address_____

Chemical & Mechanical Engineers OPPORTUNITY



Air Products offers you the opportunity to advance professionally and financially in the field of low temperature processing. The company is the leader in the engineering, design, manufacture, and construction of oxygen plants and systems for the separation of low boiling point gases such as Oxygen, Nitrogen, Carbon Monoxide, Hydrogen, Methane, Ethane, Ethylene and other basic building blocks of the petrochemical industry. We must expand the entire organization to meet the increasing demands of the steel, metallurgical, and chemical industries. Huge plants are being constructed to meet the liquid oxygen demands of the guided missiles program. We need chemical and mechanical engineers who want to share in the growth and profits of a dynamic company in a new and basic industry.

Openings are available in Process Design, Project Engineering, Estimating and Economic Evaluation, Equipment Design, Sales Engineering, Manufacturing Engineering, Supervision of Oxygen Plant Operations and other areas for which you might be qualified. To arrange confidential interview, send resume to Technical Personnel Manager.

Air Products
INCORPORATED
P.O. Box 538 Allentown, Penna., U.S.A.

ADVERTISING MAN WANTED FOR TECHNICAL PRODUCTS

- Previous advertising experience not necessary but helpful. Must have at least two or three years of college with courses in engineering and technical subjects and like to write
- If you have the qualifications we have an opportunity open for you.
- Man selected will be trained in all phases of industrial advertising.
- In your letter of application state age, education, positions held, and give statement of why you want a career in advertising. Location: well-known Connecticut company.

P-1909, Chemical Engineering
330 W. 42 St, New York 36, N. Y.

CHEMICAL ENGINEER

The Borden Company Chemical Division has opening at Philadelphia in plastics manufacturing plant serving the plastics industry for over 40 years.

Minimum experience record of 8 years. Production operation phase of the business requires capable man with ability to head up Chemical Process Engineering section dealing with equipment, processes and yields. Experience on troubleshooting, analysis of process costs and complete project investigation are necessary.

Excellent opportunity in expanding operation. Specific experience on phenolic, urea or melamine production would be desirable. Please send resume with reply.

P-2259, Chemical Engineering
Classified Adv. Div., P.O. Box 12, N. Y., 36, N. Y.

CHEMICAL ENGINEERS

$5,000 - $10,000 and up

Vegetable fats and oils production and processing and industrial chemicals mfg. We have a number of openings with top Minneapolis firms. Excellent opportunities. Send resume to:

WALKER EMPLOYMENT SERVICE
212 S. 7th St., Minneapolis 2, Minn.

CHEMICAL ENGINEERS

An active, confidential service! Interview at your convenience.
Call, write or wire
GLADYS HUNTING (Consultant)
DRAKE PERSONNEL, INC.
220 So. State St. Rm. 628 Chicago 4, Ill.
HArrison 7-8806

JUNIOR CHEMIST

$600 Month

A graduate chemist with 1 year of experience in solderless wiring devices & fixed capacitors. Unusual opportunity for advancement. Agency fee & relocation expense assumed by company.

MONARCH PERSONNEL
28 E. Jackson Blvd. Chicago 4, Ill.

REPLIES (Box No.): Address to office nearest you c/o This publication Classified Adv. Div.
New York: P. O. Box 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)
LOS ANGELES: 1125 W. 6th St. (17)

POSITIONS VACANT

Graduate Engineers, Preferably chemical for both headquarters consulting and field sales work. For sales, should have 3 or more years successful record. For consulting, young men preferred so that our business can be taught and they can move up. Write P-9197, Chemical Engineering.

Metallurgists: Company engaged in basic process and Pyrometallurgy requires several men for production development and quality control who have some experience in one or more of the following: smelting and refining, steelmaking, or electric furnace operation. Excellent opportunities for qualified men. Hospitalization, insurance and pension plan provided by company. Plants located Midwest, North and South. All replies held strictly confidential. Submit detailed resume to Box #368 Niagara Falls, N. Y.

Wanted: Mechanical or Electrical Engineer, B. S. Degree, 25-30. Three to five years experience in chemical or food process engineering. For general engineering work, including process studies, heat and material balances, structural design, equipment design, field engineering, and drawing board. Salary commensurate with experience and ability. Please send brief resume of personal history, education, professional experience, including present position, and salary desired to: Edgar B. Cole The Amalgamated Sugar Company P. O. Box 431, Ogden, Utah. Replies will be held in strictest confidence.

Assistant Chief Engineer age limit 45. Must be graduate mechanical, chemical or civil engineer with natural mechanical ability, excellent practical and supervisory and some construction experience, for charge under Chief Engineer of all shops, foundry, mobile equipment including loading, marine, railway and construction; maintenance and repair of all types of equipment; 7200 KVA diesel generating plant. Mine and mill 2600 tons/day. Flotation Mill Copper. Salary open. Foreign. With initial letter send full experience, references, age, marital status, number and age of children. Reply: Cyprus Mines Corporation, 523 West Sixth Street, Los Angeles 14, California.

Chemical Sales Engineer wanted by American firm in Japan representing prominent U.S.A. manufacturers of all types industrial chemicals including dyestuffs. Must be experienced and qualified to sell to customers and direct native sales force. Apply P-2194, Chemical Engineering giving references, resume of education, experience, salary expected.

Chemist, recent graduate, B.S. or M.S., physical chemistry major, organic minor preferred; for applications research on new products, chemicals, fillers, polymers; experience desirable but not required. Diversified company in midwest. Send complete resume to: Personnel Department Diamond Alkali Company 341 Union Commerce Bldg., Cleveland 14, Ohio.

SELLING OPPORTUNITY OFFERED

Manufacturer of Heat-Transfer apparatus & pressure vessels required additional sales representation in East. Contacts in Chemical Plants, Marine, oil refineries and power plants desirable. RW-1952, Chemical Engineering.

EMPLOYMENT SERVICES

Salaried Positions $5,000 to $35,000. We offer the original personal employment service (established 46 years). Procedure of highest ethical standards is individualized to your personal requirements. Identity covered, present position protected. Ask for particulars. R. W. Bixby, Inc., 553 Brisbane Bldg., Buffalo 3, N. Y.

Salaried Personnel, $5,000-$35,000. This Confidential service established 1920, is geared to needs of high grade men who seek a change of connection, under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. L. P. O. Box 674, Manchester, Vermont.

POSITION WANTED

Chemical Engineer: B. Ch.E. 1953. Veteran. Age 29. Family. 2 years, production Supervisor; 1 year, Project Engineer (same company). Desires responsible position with future. Minimum $9000. PW-2122, Chemical Engineering.

OUTSTANDING OPPORTUNITIES FOR CHEMICAL ENGINEERS & CHEMISTS WITH

Nitrogen Division

ALLIED CHEMICAL & DYE CORPORATION

BASIC QUALIFICATIONS

0 to 8 years' experience with Ph.D, MS or BS degree

OPENINGS

CHEMICAL ENGINEERS

- Chemical Engineering Design
- Process Improvement
- Pilot Plant Process Development
- Plant Operation

CHEMISTS

- Analytical Research
- Fertilizer Research
- Pilot Plant Process Development
- Plant Operation

LOCATION

Ultra-modern buildings, and equipment, congenial atmosphere, and pleasant working conditions at Nitrogen's new Development Center. Enjoyable climate and excellent living conditions in surrounding locality.

SEND RESUME TO

DIRECTOR OF DEVELOPMENT
NITROGEN DIVISION
HOPEWELL, VIRGINIA

FOR RATES OR INFORMATION

About Classified Advertising

Contact The McGraw-Hill Office Nearest you.

ATLANTA, 3, 1321 Rhodes-Haverty Bldg.
R. POWELL—*WAlnut 5778*

BOSTON, 16, 350 Park Square
H. J. SWEGER—*HUbbard 2-7160*

CHICAGO, 11, 520 No. Michigan Ave.
W. HIGGENS—*MOhawk 4-5800*

CLEVELAND, 15, 1510 Hanna Bldg.
W. SULLIVAN—*SUperior 1-7000*

DALLAS, 2, Adolphus Tower Bldg., Main & Akard Sts.
G. JONES—*PRospect 5064*

DETROIT, 26, 856 Penobscot Bldg.
W. STONE—*WOodward 2-1793*

LOS ANGELES, 17, 1125 W. 6 St.
P. CARBERRY—*MAdison 6-9351*

NEW YORK, 36, 330 West 42 St.
S. HENRY—D. COSTER
R. HATHAWAY
R. LAWLESS—*LOngacre 4-3000*

PHILADELPHIA, 3, 17th & Sansom St.
H. BOZARTH—E. MINGLE
Rittenhouse 6-0670

ST. LOUIS, 8, 3615 Olive St.
W. HIGGENS—*JEfferson 5-4867*

SAN FRANCISCO, 4, 68 Post St.
W. WOOLSTON—*DOuglas 2-4600*

DOWELL

Chemical Engineers
Mechanical Engineers
Industrial Engineers
Chemists

Unlimited opportunities for advancement—applied science and engineering sales. Fast-growing service company offering chemical cleaning (boilers, lines, process equipment) to all phases of industry. Locations through most of U. S. Car furnished after training program; retirement, vacation, insurance benefits; interesting, challenging work.

DOWELL INCORPORATED

P. O. Box 536 Tulsa, Okla.

Subsidiary of

THE DOW CHEMICAL COMPANY

Additional Employment Advertising On Following Page

ENGINEERS
Equipment

Immediate openings for men with 2 to 5 years experience in development, selection and application of mechanical equipment for petroleum and petrochemical plants. Duties will include considerable vendor and customer contacts and field trouble shooting.

Recognizing the need for the professional growth of the individual engineer, Kellogg provides a variety of stimulating assignments and encourages membership in engineering societies and associations. As a result, the company has grown steadily for 55 years to become a world-wide leader in the petroleum and chemical plant field. The most modern facilities are available in a brand new air-conditioned building, centrally located convenient to transportation serving suburban residential areas.

Please send resumes, including salary requirements, to R. L. Slocum. All inquiries in confidence.

M. W. KELLOGG CO.

711 Third Ave. New York 17, N. Y.

Chemical Engineers

Production Engineering or Research and Development experience preferably with acids, heavy chemicals, and/or explosives. Excellent starting salary, benefit program, and advancement opportunity. Submit resume of education and experience to:

Liberty Powder Company
Wabash River Division
Newport, Indiana
Subsidiary of Olin Mathieson Chemical Corporation

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES . EQUIPMENT - USED or RESALE

RATES

UNDISPLAYED

$1.80 a line minimum 3 lines. To figure advance payment count 5 average words as a line.

BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED

The advertising rate is $16.95 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

Send NEW ADVERTISEMENTS or Inquiries to Classified Advertising Div. of Chemical Engineering, P. O. Box 12, N. Y. 36, N. Y. for September issue closing August 3rd

COLLOID CHEMIST

able to lead production and development of non-woven fabrics (chemical and physical bonding of textile fibers) WANTED. Unusual life opportunity for qualified person.

P-2287, Chemical Engineering
Class. Adv. Div. P.O. Box 12, N.Y. 36, N.Y.

NEW AND GOOD-AS-NEW EQUIPMENT

1—Stainless Tank #430 Chrome, vert. 7'x10' deep.
20—Jacketed Kettles—Stainless, Copper, Aluminum.
1—Day Mixer, steam jacketed, 50 gal. Sigma Blade.
1—Copper Evaporator, steam jacketed, 9'1"x3'9".
60—New Pressure Cookers, 16"x18" & 24"x28".
150—Pumps—steam and electric.
1—New Glass Nash Centrifugal Pump, 100 gpm.
1—New Nash Vacuum Pump Type AL-572.
1—Sutlovak Jacketed Impregnating Tank 42"x52".
1—Stedman Disintegrator, size 40-S.
1—Abbe Ball Mill, 56"x42" Buhrstone lined.
#316 Stainless Steel Tanks, new 100, 200 & 360 gal.
1—Nash Air Compressor, Type AL-623.
1—Manton Gaulin Stainless Homogenizer, 125 gph.
1—I&R Vacuum Pump, 5 H.P., 60'.
4—Heat Exchangers, 12" dia. 11' lg., 43 steel tubes.
1—Stoker Single Punch Tablet Machine.
1—Raymond 8" Hammer Mill, like new.
Davenport Rotary Steam Tube Dryer, 6'x36'.
1—New Louisville Continuous Filtering Machine.
2—Stainless Steel Steam Jacketed Readco Mixers.
1—#316 Stainless Reactor, 265 gal. cap., jacketed.
Abbe Pebble & Tube Mill, 5'x22'—Buhrstone Lined.
1—Patterson Ball Mill, porcelain lined, 17"x27".
1—Patterson Ball Mill, 42x36, jacketed.
2—Large Steam Jacketed Horizontal Mixers.
Robinson Pulverizer #20, with 2 motors 10 HP each.
2—Ribbon Type Mixers, 50 & 90 cu. ft.—like new.
4—Steel Tanks 90,000 gal. ea. vert. welded const.
4—Horizontal Retorts 200# w.p., A.S.M.E., from 12" to 24" dia., 4' to 12' long.
2—Crystallizers—10' long.
3—3,000 gal. jacketed Kettles with Turbo Agitators.
1—#10 Day 300 gal. jacketed Sigma Blade Mixer.
4—New Heat Exc. 60' with Cupro Nickel Tubes.
1—Sparkler Stainless Filter Model 33-S-9.
3—2500 gal. Pfaudler G/L Tanks & 5/8 Agitators.
6—Blackburn-Smith Jacketed Filters, 20 to 160 gpm.
1—Jeffrey Vibrating Conveyor, 15' long.
1—Meade Mill #2 with 7½ H.P. Motor.

H. LOEB & SON :-: 4643 LANCASTER AVE., PHILADELPHIA 31, PA.

Available

MANUFACTURERS' REPRESENTATIVES

SERVING

CHEMICAL PROCESS INDUSTRIES

Well established manufacturers' representatives concentrating on sales in the chemical process industries desire an additional line harmonious with existing representation of: specialized fabricated process equipment, crushers, grinders, continuous and batch heat-treating furnaces, packaging equipment.

Territory: New York, New Jersey, Pennsylvania, Delaware, with headquarters in Metropolitan NYC area. Please reply to:

Edward F. James, Pres.
Technical Sales Associates
29 Park Court, Verona, New Jersey

LIQUIDATING COMPLETE PLANT

located in the South West

Principal equipment:

- 317 HP Gas Fired Boiler
- Inconel Evaporator compl.
- Pfaudler 1000 Gal. Reactor
- Stainless & Steel Tanks
- Bird Rub. Cov. Centrifugals
- Mikro Pulverizer No. 2
- Complete Laboratory
- Air Cond. Water Conditioning
- 10 Acres; 6 Buildings
- Ample Supply Natural Gas

Good for Chemicals, Food, Pharmaceuticals, etc. Write

Mr. FRF; 209-10th St. Bklyn. 15, N. Y.

5 MINES

FOR SALE OR LEASE

Containing—Gold, Silver, Quick Silver, Copper, Lead, Zinc and Manganese.

Picked out of 1219 Mines investigated, excellent possibilities, write to:

PROPULSORA DE MINAS, S.A.
Balderas 36 Offices 802,
Telephones. 21-55-13- 21-55-14
Mexico, D.F.

SENIOR ENGINEER

Experienced in design and construction of high pressure equipment, such as Pumps, Compressors, Vessels, Pilot Plants, etc. Estimating experience desirable but not necessary. Salary open. Give full particulars in first reply.

AMERICAN INSTRUMENT CO.
8030 GEORGIA AVE.
SILVER SPRING, MD.
In Metropolitan Washington, D. C.

WANTED

WANTED

TECHNICAL EDITORS

To provide for its continued growth Chemical Week is seeking two additional assistant editors — preferably chemists or chemical engineers with two to three years business experience. Essential: Ability to meet people, dig out facts, interpret them intelligently and write lucidly. Please submit resume to:

PERSONNEL DIRECTOR
McGRAW-HILL PUBLISHING CO.
330 W. 42ND ST.
NEW YORK 36, N. Y.

Now we can serve you BETTER

"In our new location with used and rebuilt Machinery & Equipment for the Chemical & Process Industries".

THE MACHINERY & EQUIPMENT CORP.
293 Frelinghuysen Ave., Newark, N. J.
TAlbot 4-2050

BUY OR SELL

Steel, aluminum, stainless steel, or polyephylene drums. Sizes 15-30-55 gallons.

JOHN EDWARDS
350 Rider Avenue Bronx 51, N. Y.
Mott Haven 9-4870

ACTION SALE!

BUY BELOW MARKET
CHEMICALS — DRUGS, ETC.
WRITE FOR FREE LIST OR
SUBMIT SPECIFIC INQUIRIES.
CHEMICAL SERVICE CORPORATION
80-04 Beaver Street New York 5, N. Y.

WE NEED

All Kinds of Oil Refinery and Chemical Equipment, also Tanks

Write — Wire — Phone
Weinstein Co., Div. of Surplus & Salvage Co., Inc.
610 West 8th Street Jamestown, New York

WANTED

Used Nichols Herrschoff Vertical Roaster

Please reply to:

W-2358, Chemical Engineering
Class. Adv. Div. P.O. Box 12, N.Y. 36, N.Y.

SEE OUR STOCK

FOR SALE

Waste Disposal Plant including Oliver Precoat Filter 5' 3" dia. x 8' face with Nash Hytor Vacuum Pump and motor; 18' dia. leadlined steel reacting tank, piping, pumps, agitators, etc. Built 1951 —UNUSED

CENTRIFUGALS

1—AT&M Susp. 48" dia. Perf. Basket, St. St., Fume tight
2—Fletcher Susp. 40" dia. Imperf. Basket, 1 plain steel, 1 rubber covered
1—Tolhurst Susp. 26" dia. Imperf. Basket Steel
1—Bird 36" x 50" Solid Bowl, Steel
4—DeLaval Nos. 74-11; 94-01; 600
3—Sharples Centrifuges & Super D-Hydrators

DRYERS

4—Devine #27 Vacuum Shelf, 475 sq. ft.
1—Devine #23 Vacuum Shelf, 365 sq. ft.
2—Devine Vacuum Shelf Dryers, size 17, 80 sq. ft. UNUSED.
1—St. St. Spray Dryer, 19' dia. x 20' high, with Western Precip. nozzles, fans, oil burners, etc.
1—Bowen 5' dia. Stainless Steel Spray Dryer
5—Double Drum Dryers: 42" x 120"; 32" x 52"; 24" x 60"; 24" x 36"; 22" x 38"
5—Rotary Hot Air Dryers: 5'6" x 30'; 4'6" x 40'; 4'6" x 32'; 3'6" x 25'; 3' x 24'
2—Rotary Coolers: 104" x 30' and 104" x 70'
1—B & S Rotary Hot Air Dryer, 3' x 15', Everdur (Silicon Bronze)
1—Stokes 3' dia. x 15' long Jacketed Rotary Vacuum Dryer
2—Rotary Steam Tube Dryers: Louisville 6' x 30' and Ruggles Coles 4' x 30'
2—Davenport size 2A Dewatering Presses
2—Swensen Walker Crystallizers, steel, jacketed, each 30' long

EVAPORATORS—STILLS

2—Bartlett Snow St. St. Jacketed Evaporating Kettles 6' dia. x 3' deep with heavy duty agitator and 25 HP 4-speed drive.
1—Conkey 1900 sq. ft. Triple Effect, Evaporator Vertical long Herculoy tubes
1—Buflovak size 6.5 model 629D Double Effect, all stainless steel, 588 sq. ft.
1—Stainless Steel 145 sq. ft. coil, 500 gal.
1—Stokes 150 gal. St. St. Jacketed Vacuum Still
10—Columns—Aluminum, Copper & Stainless Steel

AUTOCLAVES

2—Blaw Knox ½ gal. St. St. agit. 2000# Pr.
3—St. St. T347, 13 gal. 1400# test, 50# Jkt.

FILTERS

Niagara Model 510-28 type 316 Stainless Steel Filter, 510 sq. ft. with extra set leaves.

1—Feinc 6'6" D x 6' Face String Discharge
2—Eimco 10' x 12' Rubber Covered Filter
3—Sweetland Filters: #12 (72 lvs.); # (20 lvs.); #2 (18 lvs.)
5—Cast Iron Filter Presses, 30" x 30" open delivery, 28, 35, and 50 chambers
4—Filter Presses, closed delivery, 12" to 36"

MILLS

1—Hardinge 6' D x 22" L Conical Ball Mill, Steel Liner
4—Pebble Mills 6' D x 8' L, 45" x 42"
1—Al. Ch. 6' D x 16' L Steel Lined Contin. Ball Mill
2—4'6" D x 12' L contin. Pebble Mills
1—Charlotte #50 Colloid Mill, 75 HP
1—Penna Ring Type Granulator, Trojan K3-24, 40 HP
3—Fitz. Comminutors St. St., F-8, K & D
7—Hammer Mills: Jeffrey 42 x 36; Gruendler 36 x 24; Jay Bee 75 HP; Williams 14" x 14", Williams size A, St. St. and Alumium Stedman BX-20X12
1—Sturtevant 8 x 10 Jaw Crusher
3—Attrition Mills, 30", 24" & 16"
1—Pug Mill, St. St., two 7" dia. overlapping chambers 3'9" L. Jktd.
3—Mikro Pulverizers #2-DH, 2-TH, 3TH

MIXERS—BLENDERS

2—Day 75 gal. work. cap. Stainless Steel Sigma Blade double arm jacketed mixers
2—Readco Heavy Duty Double Arm Sigma Blade Jacketed Mixers 50 gal. work. cap. 30 HP Expl. Pr. Motor. Built 1951-53
3—Sprout Waldron size 12 Ribbon Mixers, 336 cu. ft. work. cap.
3—W & P Sigma Blade Double Arm Jacketed Mixers, 50 gal. & 100 gal. work. cap.
9—Side Entering Stainless Steel Mixers, 7½ HP, 10 HP, 15 HP & 25 HP
3—Falk Vertical Agitator Drives #10-GDX, 10:1, 300 HP—UNUSED
8—Turbo Vertical Drives, #5B, 5:1, 40 HP
2—Lancaster type SKG Counter Current Mixers, 29½" dia. pan
1—Sprout Waldron type 3036 Swing Head BB Blender, 50 HP
1—Patterson 5' dia. Conical Blender

MARCO FLOW-MASTER UNITS
Stainless Steel
New in 1952—Expl. Pr. Motors

1—KACR Reactor, ser. #3127
1—Kom-Bi-Nator, 200 GPH #3114
1—AC-500 Homogenizer, #3125
2—Roto-Feed Mixers, #3129, 3130
1—DP-Dry Proportioner, #3131

TANKS

12—Aluminum, 3000 gal., 5 compart.
10—Aluminum, 500 gal., 80# WP.
1—Monel, 450 gal., ¼"
1—St. Clad, T304, 3/16"; 6500 gal. Vert.
1—St. St. 3000 gal., vert., 5/16"
10—St. St. Pressure Tanks—to 4000 gal.
20—St. St. Storage Tanks—to 1000 gal.

STAINLESS STEEL EQUIPMENT

USED EQUIPMENT IN STOCK—Tanks, Kettles, Receivers, Exchangers and Condensers, Stills, Agitators, etc.

NEW TANKS IN STOCK—From 30 gal. to 10,500 gal. sizes. Also large stock of prefabricated tank sections and heads to assure quick delivery of tanks.

CONVERTING EXISTING EQUIPMENT—(Your own equipment or our stock)—Can be done in our own shops utilizing surplus new or used materials on hand. HELIARC WELDING—Water Quenched Stabilized welds.

Equipment Bought & Sold

Plants Liquidated

BOTTLING CANNING MACHINERY PERRY SUPPLIES PROCESSING

PERRY EQUIPMENT CORP.

Phone ST evenson 4-7210

Cable—PERI

1413-21 N. 6TH ST. **PHILADELPHIA 22, PA.**

$1,000,000 LIQUIDATION
MODERN ANTIBIOTIC PLANT
LAWRENCEBURG, IND.

(25 miles from Cincinnati, Ohio)

OPERATING EQUIPMENT INCLUDES FILTRATION—FERMENTATION—EXTRACTION—CRYSTALLIZATION —FREEZE DRYING—FINISHING AND PACKAGING MACHINERY.

Send for Circular

Inspection Invited

REACTORS, KETTLES, TANKS

Stainless Steel

8—1,000, 500, 250, 200, 100 and 50 gal. jacketed, agitated Reactors.
2—Stacy 9'x35'6" Vertical Steel Fermenters 17,000 gal. with Stainless Steel coils and 125 HP Turbo Agitators.
3—Graver 500 gal. Vertical, closed Tanks, side jackets.
3—250 and 200 gal. Vertical Tanks.
20—40 gal. Portable Tanks on trucks.

Glass Lined

9—Pfaudler 250, 200, 100, 50 and 30 gal. jacketed, agitated Reactors.
2—Pfaudler 2500 gal. Vertical, closed Tanks.
6—Pfaudler 1400, 1000, 400, 350 and 200 gal. Vertical, Closed Tanks.

Steel

30—Graver 40"x37' high, Vertical Tanks, side jackets, 2400 gal.
21—Graver 40"x7' Vertical Tanks, side jackets, 500 gal.
2—Stacy 7'6"x10'9" closed, Vertical Tanks 2700 gal. with 7½ HP side entering Agitators.
9—Vertical, Closed Tanks 1000 to 20,000 gal. 4'x12', 12'x12', 15'x16', 12'x18' cone bottom.

CENTRIFUGES & FILTERS

11—Podbielniak Model 7100 Stainless Steel Centrifugal Extractors, 10 HP XP motors and accessories.
1—Bird 40" Suspended Centrifugal, bottom discharge, steel imperforate basket 30/7½ HP motor.
2—Bird-Young 4'x2' Rotary Vacuum Filters with Vacuum Pumps.
1—Shriver 24"x24" rubber covered Filter Press, 4 eye, P&F, 21 chambers, 1-¾" cake.
1—Republic 15"x16" Stainless Steel Filter Press P&F, 20 chambers.

DRYERS & OVENS

10—Stokes, Devine and National Research 8 and 10 shelf, Vacuum Shelf Dryers.
5—American Sterilizer and recision Co. Stainless Steel Sterilizers.

SELECTED ITEMS

2—17,000 gal. Fermenters with Stainless Steel coils and 125 HP Turbo Agitators.
14—I.R. Air Compressors 215 to 1500 cfm with motors and receivers.
10—York and Cyclops Ammonia Compressors 5 to 25 ton.
4—National Research Vacuum Diffusion Units Model V-10-D.
11—Podbielniak S.S. Centrifugal Extractors.
17—Stainless and Glass Lined Reactors 50 to 1000 gal.
3—Stainless Steel Stills with Condensers 150 to 500 gal.
17—Stainless and Glass Lined Tanks 200 to 2500 gal.
2—Kathabar size 250 and 500 BLT Dehumidifiers.
2—Bird-Young 4'x2' Rotary Vacuum Filters with Vacuum Pumps.
3—Precision Hot Air Stainless Sterilizers, Type B.
3—R. A. Jones Aut. Cartoners for Vials.
3—Perfectum Vial Washers.
77—Centrifugal Pumps, Stainless and Bronze.
17—Kinney and Nash Vacuum Pumps, 100, 200 and 300 cfm.
150 Recording and Control Instruments.
2500 ft. of 1", 1½" and 2" Stainless Steel Pipe.
250 Stainless Steel Valves 1" to 4".
250 Ton Steel Pipe and Valves 1" to 8".

COMPRESSORS & PUMPS

14—Ingersoll Rand Air Compressors 1500, 1300, 1000, 750, 628, 240 and 215 cfm with motors, receivers, air filters and after-coolers.
10—York Ammonia Compressors, Model D-8, 10"x7½", 8"x8", 6"x6", 5"x5" and 4"x4" with motors and accessories.
15—Kinney Vacuum Pumps 100 and 200 cfm with motors.
2—Nash Vacuum Pumps 300 cfm with motors.
77—Ingersoll Rand, Peerless, Dayton-Dowd and Worthington Stainless and Bronze Centrifugal Pumps ⅓ to 20 HP motors.

MISCELLANEOUS

5—Kathabar, Trane, Air Conditioning and Dehumidifying Units.
35—Lightnin and Turbo Agitators, from ¼ HP to 7½ HP.
2—Turbo Agitators 125 HP.
1—Patterson-Kelly 5 cu. ft. Stainless Steel Twin Shell Mixer with 1 HP motor.
2—Bantam Mikro Pulverizers, Stainless Steel with motors.
3—Perfectum Model W78, W37 and W20 Vial Washers.
3—R. A. Jones Automatic Cartoning Machines for Vials.
6—Glass Lined Absorption Columns 2'x12', 14"x10'.
2—Barnstead & Precision Water Stills 100 and 50 gal. tinned copper, steam heated.
5—Stainless Steel Condensers 50 to 200 sq. ft.
150—Recording and Control Instruments, Foxboro, Brown, Beckman Ph Meters, Taylor and Manning.
10—Rotoclones Type D, Size 3½.
3—G.E. 300 KVA Transformers Form KPP, single phase, 60 cycle.
10—Fischer Porter Rotometers.
50—Stainless Steel Trucks.
1000—Stainless Steel and Aluminum Trays, Conveyors, Labelers, Unscramblers, Printers, etc.

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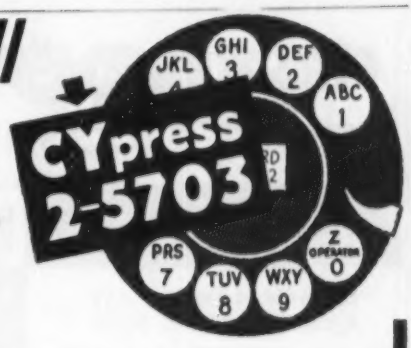

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DRYERS

2—Vulcan 6'x40', 4½'x50' Rotary.
1—Link Belt 5'2"x20' Roto-Louvre.
1—Link Belt 7'5"x25' Roto-Louvre 304 S.S.
4—Devine double door Vacuum Shelf 17 and 20—59"x78" shelves.
1—Devine 4'x25' Rotary Vacuum.
1—Devine 5'x10' Rotating Vacuum.
3—Buflovak double drum 42"x120", 42"x90", 32"x90".
2—Hersey 3'x15', 1½'x12' Rotary, 304 S.S.

FINAL LIQUIDATION

Baton Rouge, Louisiana

1—I.R. Jet Refrigeration Unit complete 208 tons 65° to 60°F.
1—Buflovak 6'x5'6" Monel Drum Flaker, NEW.
1—Pfaudler 250 gal. Hastelloy "C" Reactor.
3—4'x13' closed 316 S.S. Reactors, 109—3'6", 316 S.S. tubes, 150 psi.
1—2500 gal. 304 S.S. jacketed Reactor.
1—Pfaudler 5'x18" Horiz. glass lined 2500 gal.
1—7500 gal. 304 S.S. clad 12'x6'x 5'6" cone.
3—Link Belt 316 S.S. 18"x12", 18"x 10', 18"x7' Twin Conveyors.
200 ft. 18" Troughing Belt Conveyor with housing.

FILTERS

2—Oliver Rotary, Monel 8'x10', 3'x2'.
1—Feinc 5'x7', 304 S.S. Rotary Vac.
1—Feinc 5'x3' Monel, Rotary Vac.
3—Elmco 18"x24", 18"x12", 316 S.S. Rotary Vac.
2—Sweetland #12, 72 and 36 leaves.
2—Sweetland #3, 75 sq. ft., 304 S.S.
1—Niagara 53 sq. ft., 304 S.S.
1—Shriver 42" P&F, 40 chambers, wood.
3—Shriver 30" P&F, 36 chambers, iron.

PULVERIZERS—CRUSHERS

2—B&J #1½, #2 Rotary Cutters.
4—Hardinge Mills 4½'x16", 6'x22", 7'x36".
1—NEW Patterson 6'x8' porcelain Pebble Mill 50 HP.
1—National 6"x12" Plastic two-roll Mill.
2—Mikro Pulverizers #2TH and Bantam.
8—Jeffrey 24"x20", 18"x12", 15"x8" Hammermills, NEW.

CENTRIFUGALS

2—Bird 40" Suspended, 347 S.S.
1—AT&M 40" Suspended, steel.
1—Bird 40" Suspended, rubber.
3—Tolhurst 40", 32", 26" Suspended, steel.
1—AT&M 36" center-slung, rubber.
1—Fletcher 30" center-slung, 304 S.S.
2—Bird 32"x50", 36"x50" steel, solid bowl Continuous.
2—Bird 24"x38", 18"x28" 304 S.S. Solid Bowl, Continuous.
2—Sharples #C-27, #C-20, 316 S.S. Super-D-Hydrators.
1—Sharples #PN-14 Super-D-Canter, 304 S.S.

SCREENS

4—Rotex double and single deck 40"x 120", 40"x84".
3—Robinson single deck 40"x84", 304 S.S.
3—S. W. single deck 40"x84", 304 S.S.

MIXERS

1—Baker Perkins 100 gal. 304 S.S., Sigma Blades, jacketed, 25 HP motor.
1—Baker Perkins #JNM-2, 50 gal., 316 S.S., Sigma Blades.
8—Day "Cincinnatus" double arm Sigma Blade 550, 200 and 100 gal.
2—Robinson 90 cu. ft. 316 S.S. jacketed, Powder.
1—4' dia., 304 S.S. Conical Blender 7½ HP motor.
9—Steel jacketed Powder, 50, 225, 265, 350 cu. ft.
1—Robinson 4000# steel Powder.
1—Simpson Intensive Mixer #0.
8—NEW Portable Agitators ¼ to 5 HP.
4—Day, Ross 8 and 50 gal., Pony.

TOWERS—REACTORS—CONDENSERS & TANKS

5—Steel Storage Tanks 10'x40', 8½'x25', 8'x16', 6'x20'.
8—Towers 7'x25'6", 347 S.S., 6'x63', 6'x24', 5'x96', 30"x70', 24"x42', 12"x 30', 8"x20'.
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1—6'x34' Vacuum Tower 150#.
1—2'x50' Tower, 24 trays.
2—Convection Furnaces 20 Mil BTU/hr.
12—Welded Storage Tanks 5000, 2000, 1000, 500 bbl.
6—Steel Bldgs., 20x150, 12x20, 20x40.

MISCELLANEOUS

2—Lawrence 5" Hastelloy "C" Centrifugal Pumps.
8—Nash Vacuum Pumps #H-8, #H-7, #H-6, #4, #2, #L-5, #L-3, #MD571.
3—Stokes 412 and 212 Vacuum Pumps.
20—Durimet, Olivite 316 S.S. Duriron Centrifugal Pumps 1" to 3".
10—Centrifugal Pumps 60 to 2000 gpm. motor driven.
4—Stokes DD82, D83, "R", "T" and "F" Tablet Machines.
1—Stokes 21-J, 304 S.S. Granulating Mixer.
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Bird Continuous Centrifugals Con. Bowl; 18" x 28" & 36" x 50"	2 Dowtherm Resin Kettles 8' x 10' Jktd. Agtd. 316 S/S
Pfaudler Gl. Lined Reactors Jktd. Agtd. up to 1000 Gal.	Shriver 42" C. I. Filter Presses 39 Chambers; 4 eye; Cl. Delivery
Sharples C27 Type 316 S/S Super-D-Hydrator; 30 HP XPL	Fatty Acid Distillation Unit Type 316 S/S; Dowtherm; Complete
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3—New Pfaudler 500, 300, 200 gallon glass lined jacketed kettles
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- 1—Republic 15" x 15" Flexmaster Stainless Steel Filter, 15 ch.
- 2—Sperry C.I. 24" x 24", 4-eye, closed delivery, Plate and Frame Filter Presses, 45 ch., with hydraulic closing device, 2" frames.
- 10—Sweetland #12 Filters with 72 Stainless Steel Leaves.
- 1—Komarek-Greaves Briquetting Machine 22½" x 10" (New).

- 1—Graver Vertical Stainless Steel Storage Tank, 3500 gallons.
- 10—Aluminum Horizontal Storage Tanks, 17,000 gallons.
- 1—Baker Perkins Ter Meer, Type 316 Stainless Steel Centrifugal Filter, Model HS—24"
- 1—Type 316 Stainless Steel Bubble Cap Column, 4' x 35', 20 trays.

CENTRIFUGALS:

- 2—Bird Continuous Centrifugal Steel Filters, 24" x 38".
- 1—AT&M Type Centrifuge with 18" perforated basket.
- 1—AT&M Stainless Steel Centrifuge, 48" Imperforated Basket, complete with motor and plow.
- 1—Fletcher Stainless Steel Suspended Type Centrifuge 40" perforated basket, complete with motor.
- 3—Sharples Stainless Steel Super-Pressurite Centrifuge, Model 16Y
- 1—DeLaval Type 316 Multimatic Centrifuge.

DRYERS AND KILNS:

- 1—Stokes Rotary Vacuum Dryer Model 59 AB.
- 1—Stokes Rotary Vacuum Dryer, 30" x 12'.
- 1—Hardinge Rotary Dryer, 7'6" x 55'.
- 1—Buflovak Double Drum Dryer, 42" x 120", ASME, complete.
- 1—Bartlett & Snow Rotary Dryer, 4'6" x 36'6".
- 1—Link Belt Roto Louvre Dryer, Model 502-20.

AUTOCLAVES—KETTLES—TANKS

- 1—H.K. Porter Stainless Steel Jacketed, 500 gal. Reactor.
- 1—Stainless Steel Jacketed Reactor, 125 gallons.
- 2—Central Iron Works Type 316 Stainless Steel Reactor, 200 gallons and 250 gallons.
- 1—Emerson Schuring Stainless Steel Jacketed Vacuum Reactor, 550 gal.
- 3—Aluminum Vertical Storage Tanks, 12,000 gallons each.
- 1—Pfaudler Glass-lined Jacketed Reactor, 200 gals.
- 1—Pfaudler Glass-lined Jacketed Kettle, 10 gallons.
- 6—Patterson Steel Jacketed Kettles, 2500 gallons each.
- 11—Pfaudler Glass-lined Storage Tanks 30, 50, 100 and 500 gals.

MIXERS:

- 1—Day Type 316 Stainless Steel Sigma Blade Jacketed Mixer, 200 gals.
- 10—Baker Perkins Double Arm Sigma Blade Jacketed Mixers, 100 gal.
- 1—Readco Double Arm Sigma Blade Jacketed Mixer, 50 gallons.
- 1—Baker Perkins Laboratory Mixer, Size 4AN2, .07 gal. cap.
- 1—Day 50 gallon Gearless Pony Mixer.
- 4—Patterson Side-entering Agitators, with 25 HP Explosion-proof motor.

FILTERS:

- 2—Sperry Cast Iron Plate and Frame 4-eye Closed Delivery Filter Press 24" x 24" with 35 ch. ea., Hydraulic Closing Device.
- 1—Sperry C.I. 36" x 36" 4-eye Closed Delivery Plate and Frame Filter Press with 35 ch.
- 1—Oliver Rotary Vacuum Filter, Rubber-lined, 3' x 6' complete.

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Disintegrator: Rietz RD-18 st. steel, 75 hp.
Dryers: Devine 2 x 4' vac. drum st. steel.
Bowen laboratory Spray type.
Devine vacuum 5-shelf.
Devine vacuum 20 shelf.
Ruggles Coles XA 4 x 20' rotary.
Double drum atmospheric to 120".
Rotary Vacuum 2½ x 8'.
Louisville, Davenport Steam Tube.
Evaporators: Swenson triple effect 350 sq. ft., single effect 350 sq. ft.
Mojonnier st. steel, 392 sq. ft.
Rogers Special 6' stain. steel.
Exchanger, heat: Walker Wallace st. steel, plate type, 200 GPH.
Filters: Oliver 2½ x 1', Sparkler, Alsop, Lomax, Industrial, Oliver 5" horizontal.
Filter Presses: Sperry, Shriver 6" to 36".
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Dopp 150 gal. dbl. act. st. agitator.
Mills: Pebble, Abbe #5, 36 gal.
Ball: Hardinge 6' x 36" buhr. lined.
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Hammer: Williams size BX type AK.
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Raymond laboratory Screen Mill.
3-roll: Ross 12 x 30". Lehman 5 x 11".
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August 1956

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• Products listed feature code numbers which show the page on which they appear. L (left), R (right), T (top), B (bottom) indicate ad location; A, B, C, etc. and a, b, c, etc. identify specific product items on an editorial page or in an ad.
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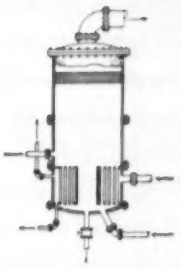

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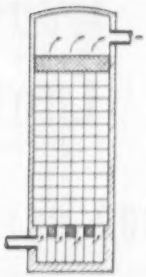

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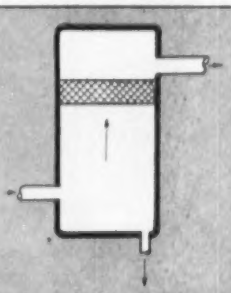

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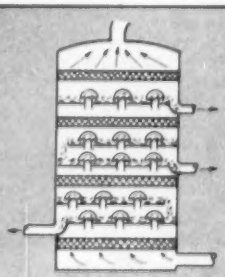

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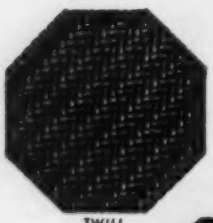
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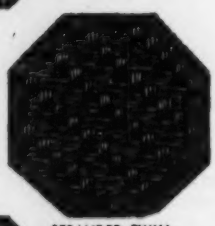
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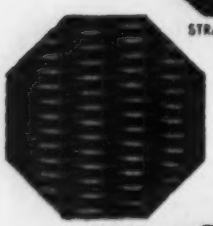
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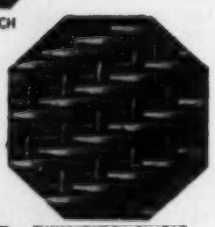
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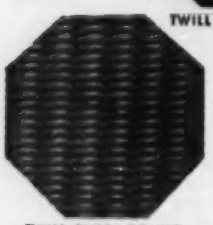
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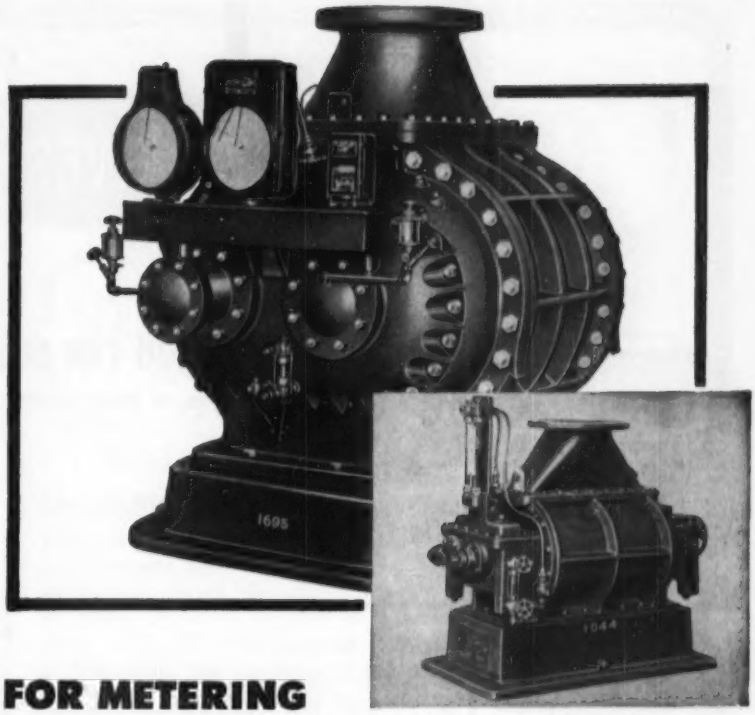

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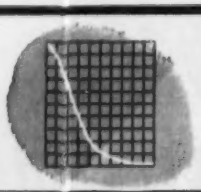

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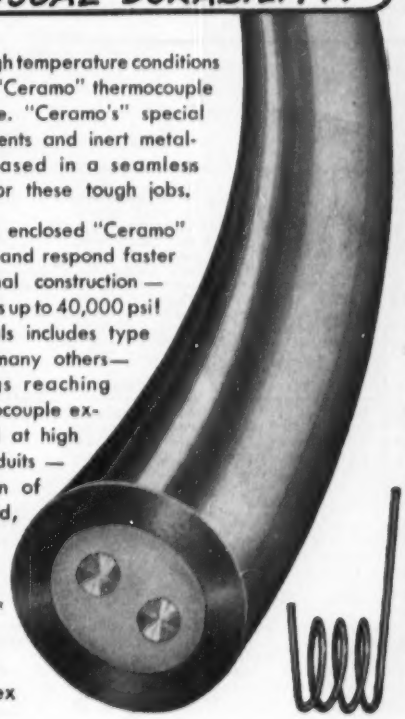

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416V Becco Chem. Div.

*From advertisement, this issue

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Electrochemicals.....Series of informational product bulletins cover sodium and potassium chlorate, ammonium and potassium perchlorate and manganese dioxide. Include analysis, description and applications.
417A American Potash & Chem.

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417B Witco Chem. Co.

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Emulsions, Piccopale A-1.....Bulletin discusses 10 outstanding properties of Piccopale A-1 Emulsion, a newly introduced low-cost, quality-improving modifier for rubber-base paints. Available on request.
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121 *Nitrogen Div., AC&D

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417E Heyden Chem. Corp.

Gelling Agents.....(For oil well treating). Specially compounded salts (soaps) of fatty acids which have the ability to gel petroleum hydrocarbon solvents at room temperature. Technical Service Report No. G-4.
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417G Witco Chem. Co.

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154 *Lithium Corp. of America.

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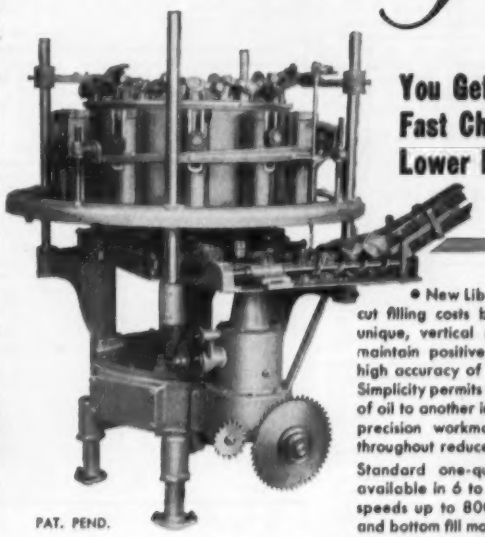

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NEW GAS GENERATOR
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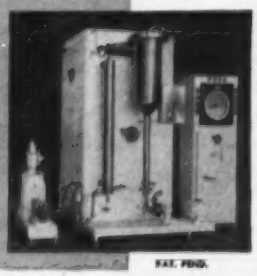


PAT. PEND.

S-I-A GAS GENERATOR—Compact unit produces protective atmospheres from natural gas or commercial propanes for processing and packaging. Provides a constant, oxygen-free atmosphere to prevent product deterioration. A range of standard models are available to meet a variety of needs including bulk or package storing, dehydrating, drying, or metal, glass and plastic packaging. Manufactured by Barmotive Products, Inc. *Exclusive Eastern sales representative:* W. F. & John Barnes Co.

BARNES ROTO-JET HEAT EXCHANGER—New heat exchange system utilizing steam injection for sterilizing liquid and semi-liquid products. Purified steam is injected directly into the product without heat loss, insuring maximum efficiency and economy. Unique control system maintains processing temperatures within ± ½-degree F., and exacting instrumentation affords a balanced product moisture content. *Manufactured and sold by:* W. F. & John Barnes Co.

WRITE FOR COMPLETE SPECIFICATIONS—or ask an experienced Barnes Sales Engineer to help you with any specific problem.

W. F. & JOHN BARNES

Builders of Better Machines Since 1872

FOOD & CONTAINER SECTION

436 S. WATER ST. • ROCKFORD, ILLINOIS

DOLE ASEPTIC CANNING EQUIPMENT
RETORT BASKET LOADERS AND UNLOADERS

Olefin Oxide.....New bulletin gives structure, typical properties and chemical reactivity of C_{12}-C_{20} olefin oxide. Lists a number of suggested uses as intermediate, solvent and specialty chemical. Bulletin 74.
418A Becco Chem. Div.

Oxides, Chromium.....Most stable of the green pigments, unaffected by acids, etc., non-fading. The 4 pure chromium oxides withstand ceramic temperature; the 2 hydrated used for brilliant color. Data & samples.
369 *Williams Colors & Pigments.

Paraformaldehyde.....No need for heated storage tanks or large storage area when you use paraformaldehyde. Same output from smaller kettles; lower steam, electricity and cooling costs. For details, see Bulletin N-30.
79 *Celanese Corp. of America.

Polyethylene.....Offers new 14 p. brochure describing currently available grades of low molecular weight A-C Polyethylene. Gives actual and suggested end uses for these versatile polymers. Bulletin No. 116.
123 *Semet-Solvay Div.

Resins.....Epon resin coatings based on the XA-200 formulation . . . find outstanding success in the chemical process industries. Brochure covers full Epon coatings story—"Planning to Paint a Pyramid?"
111 *Shell Chem. Corp.

Resins, Ion Exchange.....Nalcite Ion Exchange Resins do the job efficiently . . . with both high capacity performance and outstanding resistance to attrition losses. Request technical data on Nalcite ion exchangers.
359 *National Aluminates Corp.

Resins, Tetrafluoroethylene.....Teflon tetrafluoroethylene resins used extensively in process industries. Offer chemical inertness, high heat resistance, low-temperature toughness, etc. Properties & applications.
269 *E. I. du Pont de Nemours.

Soda, Caustic......"Caustic Soda Buyer's Guide" contains helpful facts on economics of 50% & 73% solutions; other forms of caustic soda; capacities of tank cars & other containers; useful shipping data; etc.
324a *Hooker Electrochem. Co.

Sodium Nitrite.....Sodium Nitrite is being used, alone & in combination with other materials, for the cleaning, neutralizing & protection of metals in diverse applications. "Sodium Nitrite for Rust & Corrosion Prevention."
149 *Solvay Process Div.

Sodium m-Silicate.....Valuable data on Drymet anhydrous—the most highly concentrated form of sodium m-silicate. Drymet File Folder contains complete technical information and suggested formulations.
B448 *Cowles Chem. Co.

Solubilizers.....Describes Witco GMO, a glycerol mono oleate of the non-self-emulsifying type for dispersing or "solubilizing" alkyd resins in "odorless" paint systems. Request Technical Service Bulletin H-4.
418B Witco Chem. Co.

Solvents, Aromatic.....Cover a very wide evaporation range. Their individual characteristics satisfy specific requirements in a great variety of formulations. See, "Shell Aromatic Solvents for the Coatings Industry."
295 *Shell Oil Co.

Stabilizers.....Witco Stabilizer #30 is a high-efficiency, liquid stabilizer developed by company for polyvinyl chloride resins. Complete description & typical properties in Technical Service Bulletin S-6.
418C Witco Chem. Co.

Stearates, Metallic....."Stearates, Their Properties & Uses" lists composition of 46 metallic stearates, shows industries in which they are used & presents analysis of recommended applications. 36 p. Bulletin 55-2.
418D Witco Chem. Co.

Sulfur Dichloride.....Paints passed thru sulfur dichloride vapor dry in from 2 to 20 seconds. This drying process works on paper, wood, cloth, metal, glass & plastics. Full data & samples are available upon request.
324C *Hooker Electrochem. Co.

Tetrachloro-p-Benzoquinone, Technical.....Literature covers physical properties (appearance, melting range, specific gravity, storage stability), chemical properties, toxicology, prechemical properties, precautions in handling and analytical methods.
418E Naugatuck Chem.

Tetrachlorohydroquinone..... Bulletin page covers information on physical properties, solubility in solvents, chemical properties, toxicity and analytical methods of Tetrachlorohydroquinone (TNE).
418F Naugatuck Chem.

Thioacetamide, Stabilized.....Sulfi-Down can be used to replace not only hydrogen sulfide, but also all other reagents designed to supply sulfide ions in chemical procedures. 8 p. Manual available on request.
418G A. Daigger & Co.

o-Toluenesulfonyl Chloride.....Pure o-toluenesulfonyl chloride boils at 126° C.; is completely stable in storage; non-corrosive when shipped; reacts like a typical strong acid chloride. Request Data Sheet.
418H Monsanto Chem. Co.

Toluene.....Data Sheet gives properties and essential information for the safe handling of toluene. Includes material on shipping containers, storage, waste disposal and health hazards. See Data Sheet SD-63.
418I Mfg. Chemists' Assoc.

Waxes, Polyethylene.....Brochure for formulators and manufacturers of wax-containing industrial and consumer products covers wide range of possible applications for Epolene, a new line of polyethylene waxes.
418J Eastman Chem. Prods.

Construction Materials

Castings, Sigma Blade.....Company offers a bulletin covering the full story behind the difficult casting job of a 1500 lb. corrosion resistant, dimensionally accurate, stainless steel sigma blade. Copper Alloy AKH#4.
63a *Cooper Alloy Corp.

Castings, Stainless Steel.....32 p. of valuable and complete data on stainless castings: analyses, properties, technical data on handling and heat treatment, typical applications, how to order, etc. Request your copy.
326 *Allegheny Ludlum Steel Corp.

Coatings, Protective.....Bulletin describes how good structural design aids coatings in protecting steel surfaces. Tells how to weld, rivet & use structural materials to avoid creation of corrosion problem areas.
418K Amercoat Corp.

Keeping too busy?

You'll find our streamlined Reader Service section right up your alley. It's designed for busy engineers who want to find things fast, get more information fast. RS is easy to use, and you can bank on it.

Insulation, Industrial.....Important new additions to company's line of industrial insulation products are Eagle-Picher Hylo pipe covering and block and a full line of 85% magnesia coverings. See Form No. A-400.
418L Eagle-Picher Co.

Insulation, Pipe..... Amosite . . . the South African asbestos with long, strong, resilient fibers gives Unibestos pipe insulation greater strength and superior insulating ability. Information in Bulletin No. 109C.
96 *Union Asbestos & Rubber Co.

Linings, Lead.....Specific methods of testing and inspecting sheet lead linings and bonded or lead clad linings are detailed. Procedures for the acid wash and dye penetrant methods are presented. Bulletin 15.
418M Lead Industries Assoc.

Metals, Talide.....A tungsten carbide of superior quality, is harder, stronger, and more resistant to abrasion than any other metal. Superior where wear, heat and strain are destructive to other metals. Catalog 56-G.
310 *Metal Carbide Corp.

Pillows, Polyethylene.....Designed to retard the evaporation of liquids in open tanks and vessels up to 70%, and thus greatly increase service life of the solutions. Company makes additional information available.
418N American Agile Corp.

Plastics.....Describes plastic properties & uses of Hercocel W, new Hercules plastic based on high acetyl cellulose acetate. Qualifies as molding powder for many thermoplastic applications. Data Sheet 10-55.
298b *Hercules Powder Co.

Plastics.....Many years of research and wide practical experience are behind American Agile in the fields of plastics and corrosion prevention. For detailed information, request your copy of Brochure AA-4.
L439 *American Agile Corp.

Refractories.....Carborundum has pioneered scores of super refractories with a wide variety of properties to meet your most demanding requirements. For complete details, request new "Refractories" magazine.
243 *Carborundum Co.

Refractory Materials, Castable.....Plicast castable refractory material is readily installed . . . saves installation labor . . . withstands moisture and abrasion. Offers 12 grades with many valuable uses. See Form 38.
418O Plibrico Co.

Rubber & Plastic Materials.....Piping, pumps, valves and tanks have a wide range of temperatures, pressure, impact resistance. For details about Ace rubber and plastic materials, request Technical Data CE-50.
372a *American Hard Rubber Co.

Rubbers, Chlorinated....."Protection with Parlon"...Illustrated technical booklet describes the many uses for maintenance paints based on Parlon (Hercules chlorinated rubber). Booklet is available on request.
298e *Hercules Powder Co.

Rubbers, Fluorocarbon..... Companion brochures give properties, applications, compounding, vulcanization, and fabrication of Kel-F Elastomer —a fluorocarbon rubber with outstanding resistance to heat.
418P M. W. Kellogg Co.

Sheets, Asbestos-Cement..... "J-M Asbestocite," an illustrated, 6 p. folder, explains how asbestos-cement sheet can serve industry and shows typical applications. Details on properties, sizes, dimensional tolerances.
418Q Johns-Manville.

Silicone Products.....Brochure gives specifications on various Silicone compounds available . . . provides data on properties of Silicone Rubber . . . covers Silicone Coated Cloths. See Form No. 6903.
418R Raybestos-Manhattan.

*From advertisement, this issue

Steels, Stainless.....Rezistal 201 and 202 have practically all the desirable properties of 301 and 302, plus some of their own. They are available promptly in all forms. Data Sheets cover properties fully.
161 *Crucible Steel Co. of America.

Steels, Stainless.....Armco 17-4 PH stainless steel offers unusual combination of high strength and hardness, excellent corrosion resistance and simple, low temperature heat treatment in fabrication. Request data.
329 *Armco Steel Corp.

Surfacing, Floor.....Newest advancement in continuous search for better corrosion-proof materials — offers greater protection than conventional acid-proof floor materials. Brochure & sample of Corocrete on request.
367 *Cellcote Co.

Surfacing Material, Metal.....New development for improved mechanical seal facing—#55 Facing Material. Provides a wear-resistant, highly refractory coating of pure oxides. For complete details, request bulletin.
419A Durametallic Corp.

Tantalum.....Tantalum is immune to hydrochloric acid, nitric acid, bromine, iodine, chlorine and many others. It is strong, immune to thermal shock, unequalled in heat transfer efficiency. See Tantalum Booklet.
370 *Fansteel Metallurgical Corp.

Titanium.....Bulletin describes various uses of titanium, based on its corrosion resistance. Also contains corrosion ratings for titanium when exposed to many common types of corrosive agents.
419B Mallory-Sharon Titanium Corp.

Titanium.....Shows resistance to chloride solutions and retains useful strength up to 800-1000F. Other advantages and data on application and fabrication of titanium alloys in descriptive Rem-Cru Review.
290 *Rem-Cru Titanium.

Welding Procedures.....New 170 p. Pocket Data Book features simplified welding procedures for every base metal. Guide to improved torch and metallic arc welding, brazing and soldering. Available on request.
419C Eutectic Welding Alloys Corp.

Weldments.....New bulletin gives particular attention to the fabrication of large custom-designed weldments such as pressure vessels, bridge structures, vehicular tunnel linings, etc. See Bulletin 7001.
419D Baldwin-Lima-Hamilton Corp.

Electrical & Mechanical

Chains, Roller.....New roller chain is non-corrosive and costs 40% less than stainless steel chain. Offers advantages of savings in maintenance and lessened friction drag. Request technical data, price and samples.
419E Atlas Chain & Mfg. Co.

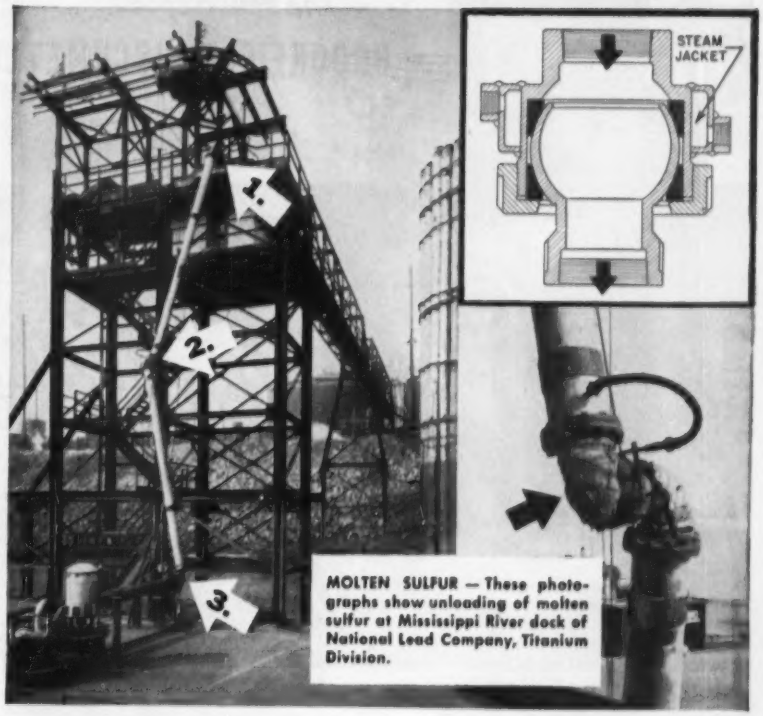
Conduits, Manhole, Above Ground..... Type GUB above ground manhole conduit provides a simple, inexpensive means for splicing main electrical feeder cables and making branch taps. Request further information.
419F Crouse-Hinds Co.

Drives, Variable Speed.....Reeves Automatic Motodrive, used in connection with modern instrumentation, provides flexible, sensitive, accurate speed control for automatic processes. For details, see Bulletin CE25-M42.
46-7 *Reliance Elec. & Engrg. Co.

Drives, Variable Speed.....Bulletin contains information about features, operating principle, design, component parts, and includes selection tables on variable speed drives with touch control. Bulletin 1600-B7.
419G Worthington Corp.

*From advertisement, this issue

Barco Steam Jacketed Flexible Ball Joints



MOLTEN SULFUR — These photographs show unloading of molten sulfur at Mississippi River dock of National Lead Company, Titanium Division.

UNLOADING LINE
Heated for Free Flow!

HOT steam is the secret of handling sulfur as a liquid at barge loading and unloading docks. Barco's new Steam Jacketed Flexible Ball Joints are an integral part of the splendidly engineered installation shown above. A traveling crane raises and lowers pipe made flexible with Barco Joints. This arrangement accommodates river stages varying up to 40 feet. This permanent, maintenance-free, labor-saving installation eliminates the problems of rapid deterioration and frequent maintenance encountered with hose.

For recommendations on how to use Barco Flexible Ball Joints in loading lines handling oil, chemicals, gasoline, alcohol and other fluids, ask for a Barco engineering field representative—located in principal cities.

FEATURES

COMPLETE LINE — Barco Steam Jacketed Flexible Ball Joints are now offered in 2", 3", 4" and 6" sizes.

TO MEET YOUR NEEDS — Straight and angle; screwed and flanged styles. Steel casing.

FLEXIBILITY — The ball provides more than 30° total angular movement in any direction.

VERSATILE—For handling sulfur, asphalt, and other heavy materials. Heat speeds flow; cuts loading time.

ENGINEERING RECOMMENDATION—Ask for a copy of new catalog 2158 on "Barco Flexible Ball Joints for Piping."

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516 J Hough Street • Barrington, Illinois
In Canada: The Holden Co., Ltd., Montreal

foods
toothpaste
resins
coatings
paint
sizings
molten glass
asphalt
solvents
greases
inks
latex
oils

With the new portable Brookfield *eight-speed* viscometer you can, *at the flick of a switch*, easily measure the viscosity of any fluid . . . readings down to 1/5 of 1 per cent with materials having viscosity of from 1 to 32 million centipoises.

If speed, accuracy, and versatility count with you, demand the new Brookfield eight-speed viscometer. A complete line of accessories makes the Brookfield adaptable to any viscosity measurement problem. Your prompt inquiry will bring complete information. Technical assistance available without obligation.

Write, wire or phone

Brookfield
ENGINEERING LABORATORIES, INC.
STOUGHTON 23, MASSACHUSETTS

Send the facts to:

LITERATURE . . .

Electrical Equipment.....12 p. catalog describes electrical equipment for cranes and monorail systems, including copper wire, bar, t-bar and enclosed conductors. For complete details, request Bulletin E-156.
420A Industrial Crane & Hoist.

Gaskets, Teflon.....The ideal seal for many process applications is a Flexitallic gasket with teflon trapped between edges of stainless steel. For complete data request folder, "Teflon in Flexitallic Gaskets."
350 *Flexitallic Gasket Co.

Gaskets, Teflon-Jacketed.....Fully illustrated reference covers Chempro's lines of teflon jacketed gaskets, solid ring gaskets, teflon expansion joints and special teflon gaskets. Request Bulletin No. CP553.
R429b *Chemical & Power Products.

Hydraulic Systems.....Newly revised bulletin illustrates how Greer hydropneumatic accumulators can substantially reduce the size, complexity and operating costs of hydraulic molding equipment. Bulletin 300.
420B Greer Hydraulics.

Magnets, Separation.....Announces new line of suspended separation magnets for use with conveyor systems. Powerful pulling force digs out imbedded tramp iron in the flow of material. Bulletin 25-D.
420C Stearns Magnetic.

Motors, Explosion Proof.....Discusses design features and maintenance of new induction motors, 1 through 30 hp., for use in hazardous locations. For details on Tri-Clad 55 motors, see Bulletin GEA-6341.
420D General Elec. Co.

Motor Starter-Circuit Breakers.....Design, construction & performance of circuit breaker & motor starter Unilets give maximum safety & unparalleled ease of wiring, installation, maintenance. Bulletin BH.
75 *Appleton Elec. Co.

Motors.....Choosing a Century motor, Performance-Rated to fit your particular job, is merely a matter of minutes when you use company's handy Application Guide. For your free copy, request Form No. 1700.
301 *Century Elec. Co.

Motors, Gear.....New bulletin presents the various types of U. S. Syncrogear motors. Shows comparative advantages of gearmotors, lists ratings from ¼ to 30 hp. with gear ratios as high as 10:1. Bulletin 1880.
420E U. E. Elecl. Motors.

Motors, Varidrive.....With a U. S. Varidrive motor you can get instantly all the speeds needed for every operating condition. For informative full color references, request Booklet Nos. 1882 and 1797.
72 *U. S. Elecl. Motors.

Motors, Wound Rotor.....Designed for use where high starting torque with low starting current is needed, power supply is limited, intermediate speeds are required, smooth acceleration is desired. Bulletin 51B8195A.
420F Allis-Chalmers Mfg. Co.

*From advertisement, this issue

Losing your friends?

Sure are, if you're not keeping in touch with our advertisers. For they're your friends, offering help through new and better products and services. You can use our Index of Advertisers to keep in closer touch with these friends and what they're doing for you.

Packings, Belmont.....For standard services "Belmont" asbestos, copper-asbestos and flax packings...lubrication is locked in . . . porosity is obtained . . . packing life is longer. Request Bulletin 4-P-8.
381a *U. S. Gasket Co.

Packings, Ring.....Furnishes complete descriptions of the Chempro lines of teflon ring packings, teflon impregnated asbestos packings, V-type packings and the patented teflon seal cage. Bulletin No. CP552.
R429a *Chemical & Power Products.

Packings, Teflon.....For all-chemical service "Chemiseal" Teflon packings ...extremely antihesive...requires no lubricant...lasts for months in service where other packings fail in hours. See Bulletin T P-1155.
381b *U. S. Gasket Co.

Saddles, Intalox.....16 p. reference offers full technical data and specifications on Intalox Saddles, including comparative charts showing relative pressure drops, flooding limits, gas pumping costs, etc.
102 *U. S. Stoneware Co.

Seals, Mechanical, Rotary.....Company announces the availability of an 8 p. reference which shows how you get maintenance-free sealing that slashes fluid mixing cost to a new low. See illustrated Bulletin B-111.
227g *Mixing Equipment Co.

Seals, Mechanical, Stuffing Box..... Offers standard, readily-available, single mechanical seal for all standard centrifugal pumps. Pumps high temperature liquids for long periods without shutdown. Circular 189.
421A Dean Bros. Pumps.

Seals, Selector.....The new Sealol Flexibox Sealector enables you to decide on seal type size and materials for your specific requirements. Covers 48 typical products handled in the process industries. Request Sealector.
L435 *Sealol Corp.

Starters, Motor.....Built in wide range of ratings for squirrel-cage, wound-rotor & Synchronous motors...for full or reduced voltage...reversing or non-reversing. Details in Bulletin No. 14B6410B.
345 *Allis-Chalmers.

Switches, Gas Pressure.....New Honeywell C437A industrial pressure switch features: sealed pressure chamber; ever visible switch position; protected settings; optional lockout mechanism. Specification S 1011-1.
421B Minneapolis-Honeywell.

Teflon Products.....Illustrates various of the many special molded & matures: tap changers, core-type conpure teflon, glass-filled teflon, glass & carbon-filled teflon & zircon-filled teflon. Bulletin No. CP554.
R429e *Chemical & Power Products.

Transformers, Arc Furnace.....Features: tap changers, core-type construction with inherently strong circular-concentric windings, dust-tight bus-bar seal, etc. For complete details, request Bulletin GEA-6236.
233 *General Elec. Co.

Transformers, Unit Substation.....Wagner Transformers, both liquid-filled and dry-type, are carefully designed to meet distribution requirements. Ratings through 2000 kva, 15 kv and below. Bulletins TU-205 & TU-214.
92 *Wagner Elec. Corp.

Transmission Equipment.....New catalog covers complete line of Dodge mechanical power transmission products. 328 p. of information, including sectional drawings, dimensions, weights, prices, etc.
421C Dodge Mfg. Corp.

Transmission Equipment.....12 p. technical brochure describes complete line of power transmission equipment, including flexible couplings, variable speed pulleys, universal joints and motor bases.
421 D Lovejoy Flexible Coupling.

*From advertisement, this issue

DENVER PROCESS EQUIPMENT
DENVER (patented) SUPER AGITATORS and MIXERS
SIZES
3'x 3' to 20'x 20'
Patented standpipe around propeller shaft assures positive agitation and circulation. Patented wearing plate prevents sand-up on shut-down. Heavy duty as well as acid proof construction is available in both open type, air lift and Super Agitator models. Please write for Bulletin No. A2-B4.
DENVER Steel-Head BALL MILL
3'x 2' to 6'x 12'
A Denver Steel-Head Ball Mill will suit your particular need. Five types of discharge trunnions. All-steel construction. Low initial cost due to quantity production. Quick delivery. Laboratory and pilot plant mills also available. Please write for Bulletin No. B2-B1.
DENVER CLASSIFERS
18" to 60" Wide Suitable Length
Denver Rake Type Classifiers are available in sizes from 1'-6" x 14'-8" to 8' x 21'-8". Denver Spiral Classifiers range in size from 6" x 5'-8" to 60" x 33'-4". Denver Hydro Classifiers are available in diameters from 6' to 55'. All are designed to efficiently separate fine particles in specific applications. Please write for bulletin No. C5C-B.
DENVER Forced-Feed JAW CRUSHER
2¼"x 3½" to 32"x 40"
Cast Steel Frame, manganese jaw and cheek plates. Large diameter shafts reduce shaft deflection and thus increase life of heavy duty, oversize roller bearings in bumper. Setting easily controlled. Please write for Bulletin No. C12-B12.
DENVER Wet Reagent FEEDER
0 cc to 2000 cc
Accurately meters minute quantities of liquid from 0 cc to 2000 cc per minute. Float valve in tank permits connection of feeder to bulk storage device. Handwheel adjustment for control amount of liquid is simple and accurate. Used in multiples for higher capacities. Please write for Bulletin No. F6-B.
DENVER Disc FILTER
1 Disc, 2' to 8 Disc, 6'
Special, patented design of segments in Denver Disc Filters use both gravity and vacuum to give a drier filter cake. Drainage is complete and positive, with no blow-back. Simple, low-cost, dependable construction. Quick delivery. Also Drum and Pan Filters. Please write for Bulletin No. F9-B2.
DENVER "Sub-A" FLOTATION
Laboratory and Commercial
Flotation is the selective separation of particles from each other in a liquid pulp by means of air bubbles. More large plants are installing Denver "Sub-A's" for their anti-flotation job, because they give maximum recovery at a low cost per ton. Dependable, low-cost, simplified continuous operation. Please write for Bulletin No. F10-B81.
DENVER Wilfley Concentration TABLES
5 to 150 T/24 Hrs.
A mechanically operated, longitudinally reciprocating table consisting of a deck having a plane surface partly riffled and a tilting device. It separates materials into bands and handles the coarsest sands with excellent results. Ideal for separation of grouts of particles having a similar range of specific gravities. Write for Bulletin No. T1-B.
DENVER LABORATORY EQUIPMENT
Batch or Continuous
Batch and continuous test models of Crushers, Screens, Ball Mills, Pulverizers, Rod Mills, Classifiers, Agitators and Mixers, Pulp Distributors, Feeders, Flotation Machines, Pumps, Thickeners, Filters, Dryers, Tables, Samplers. Results obtained on Denver Laboratory Equipment can be duplicated by commercial machines. Please write for Bulletin No. L03-B.
DENVER Standard DRYERS
2'x 15' to 5'x 40' and larger
Available in several types: Direct Heat, Indirect Heat, and Steam Tube. Let DECO Engineers solve your drying problem. No drying problem too small or too large. Please write for Bulletin No. D4-B2.
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Already thoroughly proved and accepted as a replacement for antiquated manometer-tube methods, CEC's 37-103 Electromanometer now is available in *multi-channel* form. All the advantages of the original instrument remain . . . *plus* the ability to measure up to six pressure channels sequentially with one servo-amplifier.

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CEC's Electromanometer

gives you multi-channel pressure measurement

The *all-electronic* 37-103 Electromanometer equals the mercury manometer in accuracy (0.05% of full scale) and gives you many important advantages. Whenever a fast, accurate pressure standard is required, investigate this new method of measuring pressure. Send today for Bulletin CEC 1547-X20.

Check these features:

- *up to six heads from one amplifier*
- *fast response time*
- *rugged, compact, fully portable*
- *two readouts: digital display and 10 volts electrical (analog) output*
- *negligible temperature effect*
- *remote operation: measurements can be telemetered, digitized, recorded*
- *little maintenance required*
- *interchangeable pressure heads in 1.5, 5, 15, 60, and 150 psi ranges can measure gage, differential, or absolute pressures*

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COMPANY-OWNED SALES AND SERVICE OFFICES THROUGHOUT THE UNITED STATES

LITERATURE . . .

Transmitters, Pneumatic Pressure.....The Series 1250 Ashcroft pneumatic pressure transmitter is available with pressure sensing elements in all standard pressure ranges & Bourdon tube materials. Bulletin 340.
166 *Manning, Maxwell & Moore.

Turbines.....Simplicity and adaptability of Elliott YR Turbine give it advantages that put it well ahead for pump, fan, compressor and other machine applications. Company makes details available in Bulletin H-32A.
336 *Elliott Co.

Turbines, Steam.....Turbines range from 150 horsepower down to fractional in 6 frame sizes. Feature large number of manually operated valves for individual control of steam nozzles. Details in Bulletin 135.
95 *Coppus Engrg. Corp.

Handling & Packaging

Containers, Shipping.....24 p. booklet describes one-ton shipping containers for handling liquefied and compressed gases, and chemicals such as liquid chlorine, anhydrous ammonia, sulfur dioxide. Request your copy.
422A Columbian Boiler Co.

Conveyors.....Raising and lowering loaded pallets from one floor level to another is quick, safe...and automatically accomplished with an Alvey conveyor. For description of operation of system, see Booklet 130.
375 *Alvey Conveyor Mfg. Co.

Conveyors, Lightweight.....8 p. folder illustrates and describes ten typical industrial uses for the lightweight overhead conveyor. Complete specifications are included. Company makes Bulletin 954 available.
422B Jervis B. Webb Co.

Conveyors, Power.....Catalog includes size and dimension data plus installation photos of 19 power conveyors in operation. Portable, stationary, horizontal and inclined types are shown. Request Bulletin 302.
422C Harry J. Ferguson Co.

Drums, Stainless Steel.....Hackney removable head stainless steel drums protect shipment....open easily....close tightly. Available in several sizes. For further information, request Hackney Drum and Barrel Catalog.
15 *Pressed Steel Tank Co.

Feeders, Wet Reagent.....Accurately meter minute quantities of liquid from 0 cc to 2000 cc per minute. Float valve in tank permits connection of feeder to bulk storage device. Data in Bulletin F6-B9.
421e *Denver Equipment Co.

Fillers, Piston.....New Librascope piston fillers will help you cut filling costs...vertical action plunger-type valves that maintain positive control of leakage, assure longer valve life. Specifications.
417a *W. F. & John Barnes Co.

Handling & Unloading, Hydrogen Peroxide.....Chart includes safety measures to be followed in unloading tank cars of hydrogen peroxide, and in handling, emptying and storing aluminum drums of hydrogen peroxide.
422D Solvay Process Div.

Idlers, Conveyor, Belt.....Contains design and application data, complete descriptions, dimensional drawings, specification tables and suggested applications for Limberoller idlers. Request Bulletin LD-105.
422E Joy Mfg. Co.

Loaders.....New Wheaton loader for organic chemicals and petrochemicals features spring balancing for easy operation and simple, fast packing seal replacement. Company makes further information available.
422F Wheaton Brass Wks.

*From advertisement, this issue

Loading Arms.....Use Chiksan Loading Arms for handling tough corrosives. The time proven answer where the accent is on service, safety and speed. Be sure of maintaining smooth production schedules. Chiksan Catalog.
311 *Chiksan Co.

Materials Handling.....Booklet describes use of lightweight vulcanized fibre containers to increase efficiency, reduce costs and simplify methods of materials handling. Request, "Materials in Motion . . . by National."
423A National Vulcanized Fibre.

Overload Warning Signals, Lift Truck.....New attachment warns driver either by signal light or bell (optional), that load he has just picked up is in excess of safe operating capacity of his truck. Literature.
423B Lamson Mobilift Corp.

Pulleys, Motor.....New Gerbing #51 and #57 Var'A'Cone motor pulleys, designed for use with "B" section V-belt, provide low cost variable speed. They are compact and light. Request details and bulletin.
423C Gerbing Mfg. Corp.

Scales, Automatic Bagging.....Fully describes the Richardson Model E-50 automatic bagging scale. Includes details of its numerous features, tested design, operation, capacity, etc. Request Bulletin 3749A.
100 *Richardson Scale Co.

Scales, Bagging.....Burrows Model 700 bagging scale is hand operated, can quickly and easily be attached to a feed mixer or hopper. Will bag 6 to 8 bags per minute of any free flowing material. Details.
423D Burrows Equipment Co.

Scales, Batching.....Model 700N batching scale employs a unique rotary type feeder for charging a gateless tipping type weigh bucket. Furnished in various sizes, from 100 lbs. per hour to 100 tons per hour. Bulletins.
423E Thayer Scale & Engrg. Corp.

Separators, Magnetic.....New Model LS Sanitary Ferrotrap answers the need in the chemical processing industries for low-cost sanitary protection against contamination of product or machinery damage. Bul. B-36-2.
423F Eriez Mfg. Co.

Tanks, Storage, Plastic.....Haveg plastic tanks are economical to install... easy to maintain...durable. Require no painting or costly maintenance... can be readily field repaired where necessary. Bulletin C-13.
391a *Haveg Industries.

Tractor-Shovels.....The HA "Payloader" & the larger model HAH do the work of 4 previous units. Ideal for any bulk materials you have to scoop-up, carry, load, dump, stockpile or spread. Request data.
313 *Frank G. Hough.

Trucks, Fork Lift.....Safety fork lift truck features: hydraulic starter; auxiliary hand pump; water muffler; hydraulic pressure accumulator; water manifold; mechanical gages. See Bulletin BU-335-564.
423G Allis-Chalmers Mfg. Co.

Trucks, Industrial.....Offers the most complete line of industrial trucks . . . The Master Line. Profusely illustrated booklet covers electric fork trucks, electric tiering trucks, stackers, cranes, etc. Circular 80-203.
423H Lewis-Shepard Products.

Trucks, Industrial.....The L-S Jackstacker is the most flexible and easiest to operate "walkie" in the field. Comes in straddle-type, pallet, platforms, etc. Company makes complete details available in Catalog No. 34.
423I Lewis-Shepard Products.

Trucks, Lift.....Current issue of "Handling" offers compelling clues to effective handling methods. Lead-off article tells how fork lift trucks are used in the handling of atomic waste. Request your copy.
423J Towmotor Corp.

*From advertisement, this issue

Impervite
IMPERVIOUS GRAPHITE

CORROSION PROOF PROCESSING EQUIPMENT

IMPERVITE equipment is unaffected by the action of all corrosives except a few highly oxidizing agents. This material provides excellent thermal conductivity (5 times that of stainless) and is immune to effects of thermal shock. For new equipment or replacements, consider the following facts: Original cost of IMPERVITE equipment is surprisingly low because of a high degree of standardization. Operating efficiency is of the highest level, and impervious graphite normally will provide a longer service life than any other material of construction.

TUBE & SHELL HEAT EXCHANGERS
Standard components are carried in stock for quick delivery of most IMPERVITE Tube and Shell exchangers from 7 to 650 tubes in 9 and 12 foot lengths. All normal tube and shell design features are available as standard. Custom designs are furnished on order.

CUBICAL HEAT EXCHANGERS
. . . provide maximum transfer surface in minimum space . . . and only Falls Industries offers a complete, standardized line of CUBICAL exchangers to meet most requirements. This design accommodates operating pressures in the 150 psi range.

CROSS-BORE* HEAT EXCHANGERS
Featuring a rugged, heavy-duty, one-piece bundle, CROSS-BORE exchangers are furnished in standard, single and multi-pass models for heat transfer areas to 187 square feet. CROSS-BORE exchangers are especially easy to clean, and withstand operating pressures in the 150-200 psi range.

CASCADE COOLERS
IMPERVITE Cascade Coolers feature low-pressure-drop ells and flush nozzles. As standard models they are furnished in 5 tube sizes, and three different models.

CENTRIFUGAL PUMPS*
Outstanding service is afforded by the Falls' designed seal, which is virtually leak-proof. Standard IMPERVITE pump models are furnished up to 200 gpm, 100 ft. head, and specials are available in the range of 1000 gpm.

RUPTURE DISKS*
. . . a new idea in frangibles from Falls . . . expendable and economical. IMPERVITE Rupture Disks are standard for 150# flanges, temperature to 300° F., 5% accuracy, diameters from 2" to 12". Specials are furnished to 30" diameter, to 250 psi burst, to 700° F. temperature.

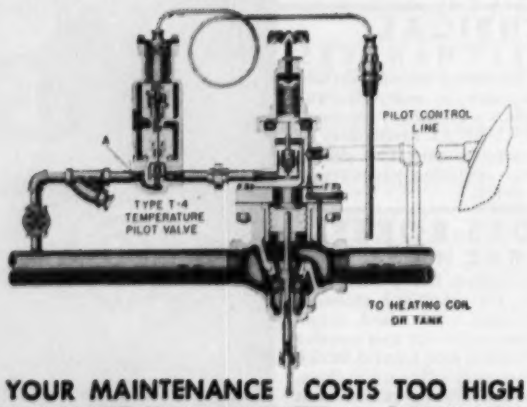
ALL IMPERVITE EQUIPMENT IS PRODUCED COMPLETELY WITHIN THE FALLS INDUSTRIES ORGANIZATION UNDER THE CLOSE CONTROL OF CHEMICAL ENGINEERS.

SEND INFORMATION ON:
- ☐ CROSS-BORE
- ☐ CUBICAL
- ☐ TUBE & SHELL
- ☐ CASCADE COOLERS
- ☐ HCL ABSORBERS
- ☐ PUMPS
- ☐ RUPTURE DISKS
- ☐ PUMPING X-CHANGERS
- ☐ PIPE & FITTINGS
- ☐ VALVES
- ☐ TOWERS
- ☐ PLATE HEATERS
- ☐ BAYONET HEATERS
- ☐ MACHINED COMPONENTS

*EXCLUSIVE FALLS INDUSTRIES DESIGN

Falls Industries Inc.
Phone, CHurchill 8-5357
Teletype, Solon 0-720
31915 Aurora Road • Solon, Ohio

... THERE'S A FOSTER TEMPERATURE REGULATOR TO CONTROL THE HEAT



ARE YOUR MAINTENANCE COSTS TOO HIGH DUE TO INACCURATE TEMPERATURE REGULATION?

MAYBE they are and you don't realize it. At any rate it will pay you to investigate the Foster line of temperature regulators for controlling temperatures of liquids and gases.

Foster manufactures a complete line of regulators for use in power or process plants, laundries and business buildings — for hot water storage heaters, fuel oil heaters, pasteurizers, ovens, driers, cookers and other heating and cooling equipment.

They are available in single or double-seated construction; direct or reverse acting for cooling. The Foster combination Pressure and Temperature Regulator reduces piping costs and assures control of temperature at any pre-determined pressure.

The Foster Type T-10 Temperature and Pressure Reducing Regulator shown here, permits not only the adjustment of the temperature being regulated, but also the adjustment and automatic regulation of the maximum steam pressure to be applied to the vessel.

All regulators are manufactured of materials to insure extra long life and minimum maintenance in any specific field.

If you have a temperature control problem, consult your Red Book for address of nearest Foster Representative, or get in touch with us direct. Ask for your copy of Bulletin T-101.

FOSTER AUTOMATIC VALVES

FOSTER ENGINEERING COMPANY

835 LEHIGH AVENUE, UNION, N. J.

- AUTOMATIC VALVES
- CONTROL VALVES
- SAFETY VALVES
- FLOW TUBES

LITERATURE . . .

Trucks, Low-Lift.....Low-lift Model "M" rider type trucks are available in both the pallet type for handling single face or double face pallets and the platform type for skid platforms. Circular 35F.
424A Lewis-Shepard Products.

Unloading, Tank Cars, Liquid Chemicals.....Covers: aqueous ammonia; lime sulfur solution; sodium silicate solution; & sodium sulfide, liquid. See "Unloading 'Non-Regulatory' Liquid Chemicals from Tank Cars."
109c *General Chem. Div.

Unloading, Tank Cars, Rubber-Lined.....The following chemicals are covered: liquid alum; aluminum chloride; muriatic acid; and phosphoric acid. For details, see "Unloading Rubber-Lined Tank Cars."
109b *General Chem. Div.

Unloading, Tank Cars, Steel.....Chemicals covered: electrolyte; hydrofluoric acid; mixed acid or nitrating acid; oleum; spent acid; sulfuric acid; & fluosulfonic acid. See "Unloading Steel Tank Cars."
109a *General Chem. Div.

Vibratory Equipment.....Electro-permanent magnetic Hi-Vi vibratory equipment needs no rectifier. Operates at 3600 CPM directly off an AC line. Units are automatically self-adjusted. Request data.
424B Eriez Mfg. Co.

Heating & Cooling

Boilers, Packaged.....Bros packaged boilers fulfill all steam requirements in the medium pressure range. Offer high steam generating efficiencies with economy of installation. See Bros Packaged Boiler brochure.
384 *Wm. Bros Boiler & Mfg. Co.

Burners, Dual Stage.....Oil burners of the steam and mechanical types now combined into dual stage burners. For the detailed description, illustration and specifications, company makes Bulletin 25 available on request.
R431 *National Airoil Burner Co.

Burners, Laboratory.....Booklet contains a complete selection of laboratory gas burners for use on artificial, mixed, natural or bottled gases. Also gives price list. Copies of Bulletin 20 available on request.
424C Central Scientific Co.

Chillers, Brine.....Circular illustrates and describes low temperature brine chillers designed to produce a constant source of brine to —120° F. for production or test applications. Request your copy.
424D Murphy & Miller.

Condensers, Evaporative.....Catalog covers complete line of "MC" heavy duty evaporative condensers. Describes construction and components of units; includes selection data, plus dimensional drawings. Bulletin 102.
424E Baltimore Aircoil Co.

Condensers, Vapor.....Contains diagrams and photographs, showing new apparatus for condensing vapors independent of a large supply of cooling water. For complete details on Aero vapor condensers, see Bulletin 129R.
424F Niagara Blower Co.

*From advertisement, this issue

Now turn to the back . . .

Simply circle the code numbers desired on the handy pre-paid postcard, and mail it to us. Replies will reach you direct from the companies manufacturing the products.

Coolers, Cascade.....Impervite Cascade Coolers feature low-pressure-drop ells and flush nozzles. Furnished in 5 tube sizes, and 3 different models. Company makes further information available on request.
423e *Falls Industries.

Coolers, Oil, Hydraulic.....Bulletin describes company's line of air type and water type hydraulic oil coolers for industrial hydraulic systems. Discusses design and construction features. See Bulletin 55-69.
425A Vickers, Inc.

Coolers, Rotary Air.....Company furnishes complete information on the Davenport rotary air cooler (6'0' dia. x 80'0' long. Cooler is of aluminum construction to cool molten alum. Request Catalog "A."
T438 *Davenport Mach. & Foundry.

Coolers, Sample Fluid.....Designed to reduce sample fluid temperatures from 600 F., to 100 F., at pressures up to 1500 psi. For sampling boiler water, high temperature process fluids, etc. See Form 2125.
425B Young Radiator Co.

Coolers, Steam-Jet.....Bulletin outlines the advantages of steam-jet water cooling units for supplying commercial quantities of chilled water at temperatures as low as 35° F. Request Form No. 9143-B.
425C Ingersoll-Rand.

Deaerators.....Bulletin describes deaerator guaranteed to provide complete deaeration. Gives operation, construction and features of downflow design. For details, see Cochrane Publication 4652.
425D Cochrane Corp.

Generators, Steam.....Describe the preengineered, standardized steam generators offered in 9 sizes, with capacities of from 50,000 to 150,000 lb. per hr. Includes drawings & design features. Bulletin B-55-4.
97 *Foster Wheeler Co.

Generators, Steam.....Vogt steam generators are available in bent tube types and straight tube forged sectional header types for solid, liquid or gaseous fuels. Request descriptive product Bulletins.
229 *Henry Vogt Mach. Co.

Heat Exchangers.....B&G .Heat Exchangers feature: efficient design, special features, precision workmanship, & correct selection & handling of materials. Request B&G catalog showing application range.
289 *Bell & Gossett Co.

Heat Exchangers.....Young type "R" heat exchangers are designed to perform under a maximum operating pressure of 75 psi and temperatures up to 300° F. For further information, request Catalog No. 1149.
425E Young Radiator Co.

Heat Exchangers.....Feature Ross high pressure closure design . . . simpler design; fewer parts to handle; greater safety factor; outer cover cannot corrode and bind; easily opened for inspection. See Bulletin 5.6K1.
300 *Ross Heat Exchanger.

Heat Exchangers.....New heat exchange system utilizing steam injection for sterilizing liquid and semi-liquid products. Company makes complete specifications on Barnes Roto-Jet heat exchangers available.
417e *W.F. & John Barnes Co.

Heat Exchangers, Cross-Bore.....Featuring a rugged, heavy-duty, one-piece bundle, Cross-Bore exchangers are furnished in standard, single and multipass models. Company makes further information available.
423d *Falls Industries.

Heat Exchangers, Cubical.....Provide maximum transfer surface in minimum space. Design accommodates operating pressures in the 150 psi range. Company makes further information available on request.
423e *Falls Industries.

*From advertisement, this issue

For good chemical resistance—

Use NFM NYLON Filter Cloth

NFM Nylon Filter Cloth is not affected by

Most common alkalies	Alcohols
Most organic acids	Carbon Bisulphide
Halogenated hydrocarbons	Carbon Tetrachloride
Aldehydes	Trichloroethylene
Ketones	Benzene

In addition, the fiber strength of Nylon ranks first among all others, whether natural or synthetic. It has excellent heat resistance. It is unaffected by mold, fungi and bacteria growths. The extremely smooth surface of Nylon makes for easy cake discharge—even extremely sticky and tenacious cakes separate freely and cleanly from the face of the cloth. This is important since it reduces blinding and increases flow rates and filter capacity.

We also weave filter cloth of VINCEL†, SARAN, DYNEL, VINYON N, GLASS, DACRON††, TEFLON***, POLYETHYLENE, ORLON*.**

...for your Filter Paper requirements try NETONE Filter Paper. High tensile strength, chemical resistant ,high burst factor, abrasion resistant and crease resistant. Send for a test sample.

Write us for test samples—when you do, tell us about your filter problems.

LOS ANGELES, CALIF.
811 WEST 7th ST.

*TM for duPont Acrylic Fiber
**TM UC&C Co.
***TM for duPont Tetrafluorethylene Fiber
†TM—NFM Reg. U. S. Pat. Off.
††TM for duPont Polyester Fiber

Weavers of Industrial Filter Media for over Fifty Years

The National Filter Media Corp.

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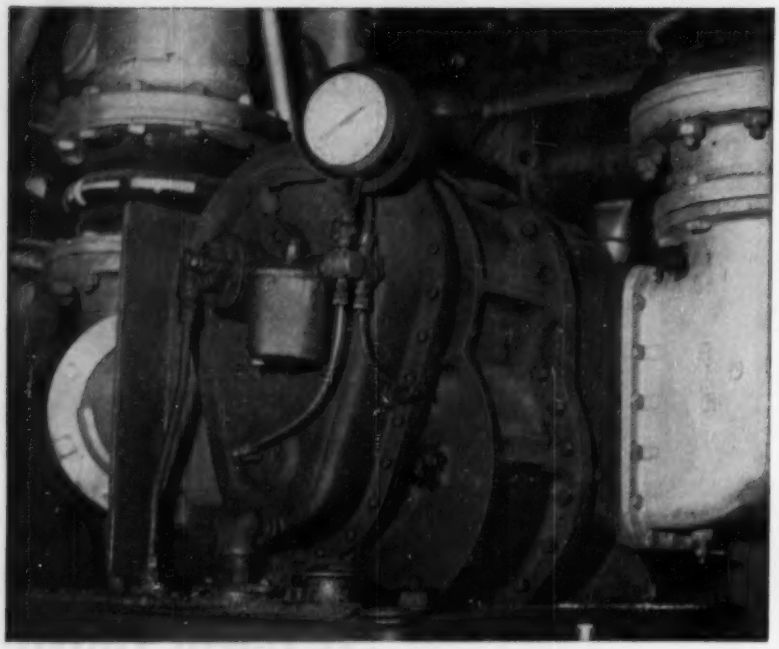
Chicago, Ill.: 3557 W. Peterson Ave.
Cincinnati, Ohio: Roselawn Center Bldg.
Houston, Texas: 1503 Hadley St.
Oslo, Norway: Nicolai Friis
Johannesburg, South Africa: Edward L. Bateman



Operates 15 months at 165% overload— *not a sign of wear*

A large eastern chemical company, requiring a continuous high volume of air, installed the 980 pound Standardaire Blower shown above to replace a 4800 pound blower of competitive manufacture.

This Standardaire model, a low pressure unit rated to operate at 1750 rpm and 4.5 psi, was forced to operate at 2200 rpm and 12 psi day and night, out of doors . . . for 15 months. During that time, it moved approximately 1⅓ billion cubic feet of air.

Disassembled to determine the effects of this gruelling run, engineers detected no discernible sign of wear. The main and gate rotors were like new. The interior was completely dry and free of oil. Axial clearance of the main rotor shaft thrust-radial bearing had increased less than 0.0005 in. Other bearings were in perfect order.

Reports such as this are not unusual. Standardaire Blowers installed throughout this country and others are performing under exceptional overload conditions for extended periods without maintenance other than lubrication. These units provide greater capacity per pound of blower with less power consumption than any other make. Write for complete information.

READ STANDARD
CORPORATION

BLOWER-STOKER DIVISION
370 LEXINGTON AVENUE, NEW YORK 17, NEW YORK

LITERATURE . . .

Heat Exchangers, Tube & Shell.....All normal tube and shell design features are available as standard. Custom designs are furnished on order. Company makes further information available on request.
423b *Falls Industries.

Heaters, Unit.....Bulletin includes hot water and steam performance tables, dimensions, selections, applications, descriptions of cabinets, elements, motor mountings, fans and accessories, etc. Request Bulletin 700A.
426A American Air Filter Co.

Heaters, Unit.....Grid unit heaters feature trouble-free heating service in the major chemical plants for over 25 years—no maintenance or repairs. Get the full story on Grid unit and blast heaters and radiation.
318 *D. J. Murray Mfg. Co.

Heating Units, Immersion.....Your fuel dollar buys more effective heat transfer with "Surface" immersion heating than with other methods of heating liquids and salts. Details contained in Bulletin SC-156.
B433 *Surface Combustion Corp.

Preheaters, Air.....The Ljungstrom boosts products quality & its heat-recovery efficiency makes possible advanced furnace designs that assure close control of processing. For information, request product data.
275 *Air Preheater Corp.

Refrigerating Machines, Centrifugal..... Compact, lightweight hermetic centrifugal cooling unit features push-button operation and low installation costs. Company makes details available in Bulletin 19C-100.
426B Carrier Corp.

Thermo-Panels.....Cost less & perform better—an improvement on pipe coils. You save space & heat or cool more efficiently. For use in heating & cooling of liquids, slurries, soaps, etc. Bulletin 255 & 256.
BL441 *Thermo-Panel Div.

Traps, Steam.....Yarway Impulse Steam Traps feature: small size-lightweight; only one moving part; stainless steel; won't freeze up. For complete information, request Trap Selector, Bulletin and Diagram.
297 *Yarnall-Waring Co.

Instruments & Controls

Analyzers, Thermal Conductivity..... Model 7C thermal conductivity type analyzer may be used to measure a number of process stream gases such as carbon dioxide, hydrogen, ammonia, etc. Request Bulletin 119.
426C Arnold O. Beckman.

Controllers.....Taylor makes available a data sheet discussing the separation of components in a batch distillation column in the shortest time at the lowest possible cost. Also other recommendations. Data Sheet 11.
94 *Taylor Instrument Cos.

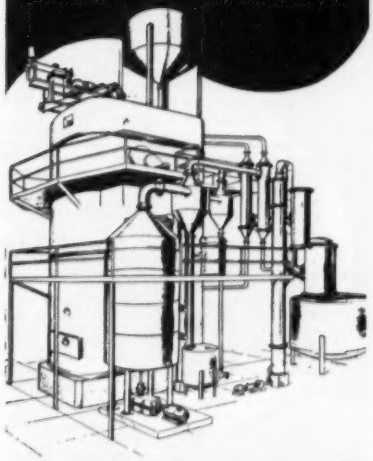
Controllers, Temperature, Electronic .....Describes the Honeywell Model 077 electronic temperature controller . . . a non-indicating device, which operates on the balanced bridge principle. Request Spec. Sheet S1010-1.
426D Minneapolis-Honeywell.

Controls, Temperature.....The Type N Hydroguard, a newly-designed water temperature control, provides greater compactness and accuracy than previously available. For further information, see Bulletin 362.
426E Powers Regulator Co.

Controls, Temperature ..... Completely illustrated, 16 p. catalog presents company's line of standard local mounted temperature controls. Includes theory, features, general specifications, etc. Catalog Section 100.
426F United Elec. Controls Co.

*From advertisement, this issue

FRENCH



EXTRACTION

EXPERTS IN REMOVING SOLUBLES FROM SOLIDS

- MINERAL ORES
- PLASTICS
- SCRAP METAL
- SPICES
- ALFALFA
- OIL SEEDS
- ANIMAL TISSUE

PROCESSING WITH FLAMMABLE SOLVENTS

SOLVENT RECOVERY

DEWATERING

For over 50 years, FOMMCO extraction equipment has had an unusual record of achievement of processing economy and efficiency in the animal and vegetable oil milling field. Now . . . the experience, research and technical knowledge of more than a half century of building extraction plants have been turned to the general chemical field.

Write today for suggestions in solving your extraction problems.

FD2

THE FRENCH OIL MILL MACHINERY CO.

EXTRACTION DIVISION

PIQUA OHIO

LITERATURE . . .

Controls, Temperature.....17 p. catalog presents company's line of remote bulb temperature controls . . . industrial, aircraft, marine, special purpose. Includes features, specifications, etc. Catalog Section 200.
386 *United Elec. Controls Co.

Detectors, Malfunction.....Details on how vibration monitors detect malfunctions in rotating equipment and how the devices are installed and adjusted. For complete details, request 4 p. Bulletin No. 500-1A.
427A Beta Corp.

Gages, Reflex Level.....The "K" Type reflex level gage has these advantages: single row of tightening bolts; body free from distortion; glass easily removed; gage body turnable, free to expand. Request literature.
143 *Klinger Corp. of America.

Gages, Thickness.....New permanent-magnet thickness gage for measuring thickness of paint and other nonmagnetic materials . . . no power required . . . measures from 0 to 60 mils. For details, see Bulletin GEA-6458.
427B General Elec. Co.

Indicator Systems, Smoke Density..... Bulletin gives operating and specification data on Fireye's smoke density indicator system FE-3. Provides installation information in schematic drawings. Bulletin CM-22.
427C Electronics Corp. of America.

Indicators, Sight Flow.....Literature describes the new line of sight flow indicators . . . easily and inexpensively installed in any new or existing pipe line ¼" to 2" N.P.T. Request detailed Date Unit.
L429 *Jerguson Gage & Valve Co.

Instrumentation, Flow.....From the simplest general utility-type instrument to complex automatic ratio control systems, you get top accuracy, efficiency, and economy. Company makes full details available.
48-9 *Foxboro Co.

Instrumentation, Pulp & Paper Mills.....Instrumentation systems for 24 sections of various types of mills are completely covered in a new 32 p. illustrated catalog. Request your copy of Bulletin 90-130-10.
427D Fischer & Porter Co.

Instruments.....Bulletin gives illustrations and complete information on more than 20 types of Alnor instruments designed for measuring air velocities, temperatures and dew points. Available on request.
B447 *Illinois Testing Labs.

Meters.....The Auto-Stop batching meter shuts off automatically . . . accurately . . . leaving the operator free to devote full attention to other details. Complete data contained in Bulletin No. 566-V.
410 *Neptune Meter Co.

Meters, Flow.....Versatile flowmeters designed for laboratory and pilot plant use. Invaluable to users of compressed gases who must determine accurate flow rates. For further information, see Bulletin No. 202-6.
427E Matheson Co.

Recorders & Controllers.....Catalog, "pH and conductivity recorders and controllers," includes details on equipment for measuring, indicating, recording, and controlling electrochemical variables. Catalog 1551.
427F Minneapolis-Honeywell.

*From advertisement, this issue

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Simply circle the code numbers desired on the handy pre-paid postcard, and mail it to us. Replies will reach you direct from the companies manufacturing the products.

KILL FOAM FAST

use DOW CORNING SILICONE DEFOAMERS

ONE OUNCE OF

ANTIFOAM A KILLS FOAM IN 160,000 lb coumarone-indene resin

ANTIFOAM A EMULSION KILLS FOAM IN 12,500 lb zinc sulfate plating bath

ANTIFOAM AF EMULSION KILLS FOAM IN 15,625 lb dill pickle processing solution

Here are the most economical, most versatile foam killers ever developed! Dow Corning silicone defoamers boost productive capacity; cut processing time; eliminate waste and fire hazard of boil-overs.

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FOOD PROCESSORS — Now permissible to use time and money saving silicone defoamers: Antifoam AF Emulsion at concentrations up to 34 ppm; Antifoam A at concentrations up to 10 ppm.

Free Sample—*make your own test — send coupon today*

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Please send me:
FREE sample of ☐ Antifoam A Compound
☐ Antifoam A or ☐ AF Emulsion;
☐ Booklet on Silicone Defoamers.

NAME _____

COMPANY _____

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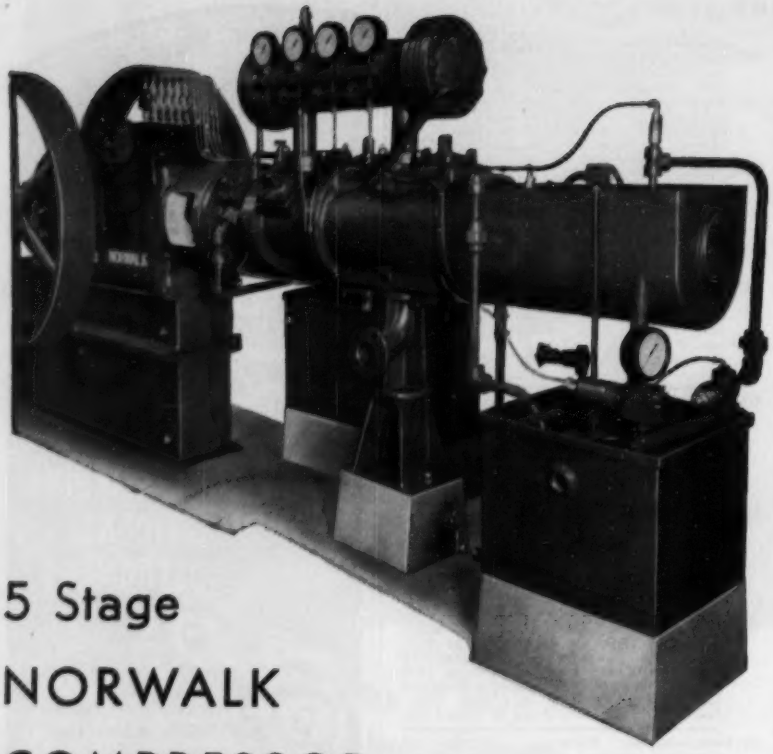


5 Stage NORWALK COMPRESSOR

built for economical performance

Frames with taper roller bearings, reversible ring plate valves force feed lubrication, generous intercooler coils are some of the features that make this horizontal duplex compressor compact, sturdy, and efficient to operate. Its five stages develop 7500 pounds pressure.

Every Norwalk compressor is test-run for eight hours at the factory, then taken down for complete inspection before re-assembly and shipment. Complete catalog describing compressors from single stage to six stages available on request.

NORWALK COMPANY, INC.

SOUTH NORWALK, CONNECTICUT

Makers of high pressure compressors since 1864

LITERATURE . . .

Meters, Positive Displacement.....For measuring gas from 4,000 cfh to a million, you can trust the qualities of R-C Positive Dispiacement meters. R-C "plur-ability" pays dividends. Details in Bulletin No. M-152.
413 *Roots-Connersville Blower.

Refractometers, Differential.....8 p. brochure discusses the theory and principles of refractometry as well as describing the new Barnes differential refractometer with features and specifications of 3 models.
428A Barnes Engrg. Co.

Regulators, Temperature.....Series V Regulator is recommended for steam, water, gases and fluids not corrosive to brass. Operates on liquid filled thermostatic system, either direct or reverse acting. Bulletin 500.
428B A. W. Cash Co.

Regulators, Voltage.....Stabiline automatic voltage regulators . . . type IE, instantaneous electronic and type EM, electro mechanical . . . are described in a new illustrated Bulletin No. S 351. Available on request.
428C Superior Elec. Co.

Scales, Coal, Automatic.....Operation, components and auxiliary equipment for two models of high-speed automatic coal scales are described in a new 16 p. bulletin. For complete information, request Bulletin 6352A.
428D Richardson Scale Co.

Switches, Gas Pressure.....Designed especially to meet Factory Mutual requirements for use on multiple burner gas installations. Company makes complete details available in Specification S 1011-1.
428E Minneapolis-Honeywell.

Telescopes, Industrial.....A.C.M.I. Borescopes permit close-up visual examination of interior areas & surfaces not otherwise visible. They save time & money & prevent costly dismantling. Request Borescopes Booklet.
B438 *American Cystoscope Makers.

Thermocouples.....T-E's new "Ceramo" thermocouples will be used to check reactor temperatures on atomic sub "Seawolf." More information on these new metal-clad, ceramic-insulated thermocouples in Bulletin 31-300-E.
415 *Thermo Electric Co.

Thermometers.....''Every Angle'' design for installation anywhere; anti-parallax maxivision dial that practically eliminates the possibility of parallax error; bi-metal actuation for high sensitivity. See Bulletin 148.
428F Manning, Maxwell & Moore.

Viscometers.....The new eight-speed Brookfield viscometer measures viscosity of any fluid. A full line of accessories makes the Brookfield adaptable to any viscosity measurement problem. Request information.
420 *Brookfield Engrg. Labs.

Pipe, Fittings, Valves

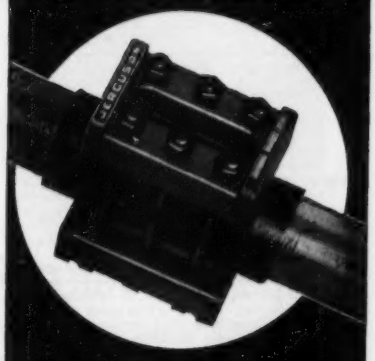
Couplings, Flexible.....Up to 15 years maintenance-free service is not unusual with Lovejoy lubrication-free flexible couplings. They are of simple yet rugged construction with double-life cushions. See Catalog.
L431 *Lovejoy Flexible Coupling Co.

*From advertisement, this issue

Now turn to the back . . .

Simply circle the code numbers desired on the handy pre-paid postcard, and mail it to us. Replies will reach you direct from the companies manufacturing the products.

NEW . . .
Jerguson Sight Flow Indicators



easily and inexpensively installed to show movement of liquid in pipe lines

Here is a new line of Sight Flow Indicators . . . easily and inexpensively installed in any new or existing pipe line ½" to 2" N.P.T.

The special design of these new indicators results in a turbulence in the flow of liquid, making it easily visible. Several types of indicating vanes, installed within the chamber, may also be furnished, according to variable conditions of rate of flow and viscosity of liquid. For indication of minute flows, small Sight Flow Indicators with a rotating vertical rising ball are available.

Jerguson Sight Flow Indicators are soundly designed, carefully made, and are backed up by a company with over 40 years experience in the field. Available in Transparent and Reflex types, in a wide variety of materials and linings, and with Wedge Type Illuminators, Haveg Chambers, Non-Frosting Glasses, or other special construction.

If you have a problem of viewing the flow of liquid in a pipe line, it will pay you to investigate the new Jerguson Sight Flow Indicators today. Send us your requirements or write for Data Unit.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Fellsway, Somerville 45, Mass.
Offices in Major Cities
Jerguson Trent Gage & Valve Co., Ltd., London, Eng.
Pétrole Service, Paris, France

LITERATURE . . .

Couplings, Flexible, Miniature.....Bulletin pictures, describes and shows dimensional drawings of miniaturized couplings which can be used on servo-mechanisms, computers, etc. For details, see Bulletin MC-100.
429A Thomas Flexible Coupling Co.

Elbows, Reducing.....Offer important advantages in both piping design & piping cost. Need only 2 welds instead of the 3 required by a standard elbow & a reducer. For full details, request Catalog No. 54.
309a *Midwest Piping Co.

Fittings, Stainless Steel.....Speedline fittings simplify pipeline design. Details of the greater design flexibility possible with Speedline fittings . . . at lower cost . . . available in new fully illustrated catalog.
TL441 *Horace T. Potts Co.

Hose, Metal, Flexible.....Engineered and manufactured to absorb the costly beating your piping system is now taking . . . efficiently and economically. Available from stock in bronze, carbon steel & monel. Bulletin IND 4.
390 *Packless Metal Hose.

Joints, Expansion.....No matter what kind of expansion joints you need. Solar can build them—ruggedly and economically. Company makes further information available in their latest Sola-Flex Catalog.
322 *Solar Aircraft Co.

Nozzles.....Describes company's line of nozzles for: oil atomizing; humidifying; air washing; desuperheating; spray ponds; milk powdering; acid chambers; concrete curing; etc. Request Catalogs 6-A and 6-C.
R437 *Monarch Mfg. Wks.

Nozzles, Spray.....New WhirlJet spray nozzle for installation on walls or manifolds . . . may be mounted in a straight line if desired, to simplify job of drilling and tapping holes in manifold or wall. Data Sheet 6666.
429B Spraying Systems Co.

Nozzles, Spray.....Company provides a 48 p. industrial catalog with full data on thousands of standard and special nozzles—for every type of spraying. Also information on related equipment. Catalog No. 24.
T444 *Spraying Systems Co.

Nozzles, Spray.....Company makes available on request a completely detailed Catalog which provides valuable data on Spraco Nozzle line. Includes information on full cone, flat spray & hollow cone types.
T446 *Spray Engrg. Co.

Pipe & Fittings, Glass.....Glass Pipe & Fittings for full-scale production operations. Strengthened by end-tempering & feature corrosion-resistance, non-contamination, etc. Catalogs EA-1 & EA-3 offer full data.
333a *Corning Glass Wks.

Pipe & Fittings, Seamless Steel, Nickel-Plated.....Ductile, adherent and pore-free electroplated nickel surface will withstand such materials as: chlorinated organics, phenol, caustic soda, etc. Request data.
378 *Bart Mfg. Corp.

Pipe Installation, Glass.....Pipe is easy to install & low in installed cost compared with other corrosion-resistant materials. Available in 6 standard sizes from 1- to 6-inch. I.D. inclusive. Installation Manual PE-3.
333b *Corning Glass Wks.

Pipe, Plastic.....Ace Rivivor is a new rigid threaded plastic pipe with good aging & high impact strength. Not affected by most inorganic acids & alkalis. Excellent for many organics. Request Bulletin CE-56.
372e *American Hard Rubber Co.

Pipe, Process, Aluminum.....Aluminum resists corrosive effects of chemicals like hydrogen peroxide, nitrogen solutions, many acids, alcohols, foods . . . and petroleum products like gasoline, kerosene. Request new brochure.
59 *Reynolds Metals Co.

*From advertisement, this issue

CHEMPRO
makes them all in Teflon!

RING TYPE PACKINGS

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V-TYPE PACKINGS

FLEXIBLE SEAL CAGES

JACKETED GASKETS

SOLID RING GASKETS

CHEMICAL & POWER PRODUCTS, INC.
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Check the Bulletins you want:

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- ☐ Teflon Stock & Special Molded and Machined Parts

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Company_____
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Increase your productivity and reduce overhead costs with smooth, *dependable* Roper Rotary Pumps. The two models illustrated (of the 3600 Series so widely used in virtually every industry) are naturals for transferring fats, oils, sirups, and similar products. Model MAHB is best suited for stationary equipment. Model HBRV is Roper's outstanding general purpose pump that lends itself to tank truck installations. The Roper principle of two moving parts — equal size gears — promotes high efficiency and holds maintenance problems to a minimum. Available in standard fitted, all iron and bronze fitted construction to suit your needs. Series 3600 pumps available in sizes 40-300 G.P.M. — pressures to 60 P.S.I.

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Rotary Pumps

GEO. D. ROPER CORPORATION
466 BLACKHAWK PARK AVE. ROCKFORD, ILL.

LITERATURE . . .

Pipe, Saran Lined.....Saran lined pipe, fittings and valves cut corrosion costs . . . can be cut in the field with available pipe fitter's tools. Liquid never touches metal in saran lined pipe. Request details.
86 *Saran Lined Pipe Co.

Pipe, Valves & Fittings.....8 p. Engineering Memorandum covers polyvinyl chloride (PVC) pipe, valves and fittings. Details corrosion resistance, general properties, fabricating characteristics, etc. Memo No. 13.
430A Peter A. Frasse & Co.

Pipe, Wrought Iron.....New booklet, "Wrought Iron Pipe for Modern Buildings," includes sections on wrought iron's resistance to corrosion and fatigue stresses, weldability, forming and threading.
430B A. M. Byers Co.

Tubes, Condenser.....Arsenical Admiralty-439 and Ambraloy-827 condenser tubes for normal service, and Cupro Nickel, 10%-755 and Cupro Nickel, 30%-702 for severe stress-corrosion cracking. Pub. B-2.
71 *American Brass Co.

Tubes, Heat Exchanger.....Alcon Alclad Aluminum Tubes withstand corrosion best. Materials like hydrogen sulfide and carbon dioxide—corrosive to most metals—are not corrosive to aluminum. Request 24 p. booklet.
77 *Aluminum Co. of America.

Tubes, Heat Exchanger.....Contain the right amount of anitmony needed to resist desincification and other forms of corrosion. For more information, request Chase Condenser and Heat Exchanger Booklet.
165 *Chase Brass & Copper Co.

Tubes, Heat Exchanger & Condenser..... Bulletin emphasizes the quality, dependability and economy of electric resistance welded carbon steel tubing in applications involving heat transfer. See Bulletin TB-412.
430C Babcock & Wilcox Co.

Tubes, Integrally Finned.....Booklet covers numerous applications where Trufin (the integrally finned tube) is used and can be used effectively and economically. Request your copy of "Opportunities Unlimited."
430D Wolverine Tube Div.

Tubing.....12 p. catalog on cold drawn mechanical, capillary, hypodermic, nickel and nickel alloy tubing. Includes data on specifications, standard tolerances, physical properties and relative workability.
430E J. Bishop & Co.

Tubing, Carbon Steel.....Bulletin furnishes condensed data on mechanical and physical properties of seamless and welded carbon steel pressure tubing. Request your copy of 4 p. technical folder TDC-142A.
430F Babcock & Wilcox Co.

Tubing, Flexible.....Hundreds of applications in the steam and Diesel power fields are filled by Penflex flexible tubing. For complete information on product line, request copy of "Flexineering" booklet.
255 *Pa. Flexible Metallic Tubing.

Tubing, Nickel & Nickel Alloy..... Features handbook information on nickle and nickle alloys for use by designers, production engineers and purchasing executives. Bulletin No. 12 gives complete details.
430G Superior Tube Co.

*From advertisement, this issue

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15 YEARS SERVICE WITH ONE SET OF CUSHIONS

... actual report on

LOVEJOY

Flexible Couplings

Up to fifteen years maintenance-free service is not unusual with Lovejoy lubrication-free flexible couplings.

Performance like this is practical proof of these soundly engineered features:

SIMPLE, RUGGED CONSTRUCTION
Fewer parts. No intricate mechanisms. Nothing to lubricate.

LOAD TRANSMITTED BY CUSHION COMPRESSION
No wear on the metal jaws.

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One half of the cushions act as idlers—except on reversible loads. A quick interchange provides a new set of cushions. This can be done without dismantling the coupling.

Illustration at right shows a Lovejoy Type CF flange-mounted coupling. Rated at 160 hp., 800 rpm., this space saver connects drive shaft between diesel power unit and generator.

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Mfrs. of Flexible Couplings, Variable Speed Pulleys and Transmissions, Motor Bases and Universal Joints.

LITERATURE . . .

Tubing, Plastic.....Excellent chemical-resistant, all-purpose flexible plastic tubing. Sparkling clear, easy to clean, odorless, non-toxic, can be steam-sterilized. For details, request Bulletin No. 66.
372d *American Hard Rubber Co.

Unions, Forged Steel.....After quick & easy installations, even in roughest spots, Orifice Unions will perform superbly in measuring, mixing, blending, strainer or blanking off services. Offers new Catalog.
B446 *Clayton Mark & Co.

Valves.....Features: non-sticking; no metal-to-metal contact; needs no lubrication; requires no packing; renewable sleeve & plug. Details on type F valves are available. Request a copy of Bulletin V/4a.
251 *Duriron Co.

Valves, Butterfly.....In this new Catalog you get the complete dimensions, layout drawings, specifications and materials for all pressure ratings of R-S Butterfly Valves that are now standardized. Catalog 160.
414 *S. Morgan Smith Co.

Valves, Check.....Fast, quiet operation means low cost operation for check valves . . . and that's exactly what the Chapman Tilting Disc Check Valve is designed to do. Data on full line in Catalog No. 30-A.
76 *Chapman Valve Mfg. Co.

Valves, Control.....Three- and four-way directional control valves for fluid power systems up to 3000 psi, are described in new 16 p. bulletin. Includes details on construction and functions. Bulletin 80200.
431A Oilgear Co.

Valves, Control.....Announces complete line of solenoid pilot-operated control valves, built to JIC standards. Speed King valves are available in single and double solenoid types. For details, see Bulletin SK-356.
431B Valvair Corp.

Valves, Control, Flow.....7 models of "Quick-Dump" valves are currently available—solenoid, cam-operated, palm button, finger-tip, foot operated and two types with hand lever. For details, see Form QD-556.
431C Humphrey Prods. Div.

Valves, Diaphragm.....From antibiotics to the toughest acids, alkalis and salts, there is a combination of Hills-McCanna body and diaphragm materials that will best suit your needs. Request Valve Catalog.
312 *Hills-McCanna Co.

Valves, Diaphragm.....Trouble-free plastic diaphragm valves—choice of general-purpose Ace-Ite, Ace Parlan (polyethylene) or Ace Saran. Handles most corrosive chemicals & food ingredients. Bulletin 80 & 351.
372b *American Hard Rubber Co.

Valves, Drain.....Offers descriptive information on line of Strahman ram type valves . . . the only drain valves that cannot clog up. Made in any cast metal to meet your requirements. Request complete Catalog.
B435 *Strahman Valves.

Valves, Gate.....Darling gate valves are made in metals, types and sizes for most services . . . and for pressures up to 1500 pounds. Feature fully revolving double disc parallel seat principle. Bulletin No. 5003.
388 *Darling Valve & Mfg. Co.

Valves, Gate, Stainless Steel.....Design factors of stainless steel valves are discussed in detail in Cooper Alloy's February issue of Newscast. Shows how stainless steel is easier to maintain. Request your copy.
63b *Cooper Alloy Corp.

Valves, Gear Operated.....Company announces the addition of optional worm gear operation to its standard line of jacketed plug valves from 2" to 8" line size in 2 and 3-way types. For details, see Catalog 356.
431D Parks-Cramer Co.

*From advertisement, this issue

NATIONAL AIROIL

Oil Burners

OF THE STEAM AND MECHANICAL TYPES NOW COMBINED INTO

Dual Stage BURNERS

Now, at last, the inherent advantages of both systems of fuel oil atomization are profitably yours . . . within the one new NATIONAL AIROIL Dual Stage Burner. 45 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner . . . and, it has been thoroughly tested and proved in the field for firing: Petroleum Processing Heaters; Rotary Kilns; H. R. T., Scotch Marine and Water Tube Boilers, etc. Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel oil from No. 2 to No. 6, with a ready capacity of 80 to 300 g. p. h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get the detailed description, illustration and specifications in the NATIONAL AIROIL Bulletin 25.

PRODUCTS

OIL BURNERS and GAS BURNERS for Industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
AIR INTAKE DOORS
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SPECIAL REFRACTORY SHAPES

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only the

USG

INDICATING PILOT

shows set point and process variable

at a glance!

No other Pilot gives you all the features available in the USG Temperature or Pressure Pilot.

This is an *Indicating Pilot*, with set point and process variable point on the same dial. It also offers:

- Standard proportional band of 1-100% . . . also available to 150%.
- Band is quickly adjustable.
- Self-contained all-metal relay (1 1/4 cfm), easily field adjusted.
- Readily accessible manual reset.
- Compact (8 9/16" sq. x 4" deep) for ease in panel or field mounting.

In operation, the USG Pilot provides a pneumatic feed-back circuit with sensitivity of 1/16% and repeatability of 1/2%. Available in a variety of temperature ranges, pressure ranges from 0-30" H_2O to 0-10,000 psi, and in vacuum ranges of 0-30" Hg., with standard control action either proportional 1 to 100% or differential gap. Automatic reset with proportional (1 to 150%) optional.

For complete data on USG Pressure Pilot write your valve supplier today. USG's creative engineering has developed a line of process control instruments that includes temperature and pressure recorders and controllers, pneumatic transmitters and receiver gauges. Write for descriptive catalogs.

UNITED STATES GAUGE

Division of American Machine and Metals, Inc.

Sellersville, Pa.

USG

Home of the SUPERGAUGE

LITERATURE . . .

Valves, Heavy Duty.....New brochure contains performance curves illustrating how round hole closing makes a difference compared with conventional pinch valves. Details on Series S valves in Bulletin No. 65.
432A Equipment Engineers.

Valves, Needle.....The Marsh needle valve is now available in 416 stainless steel throughout. It is guaranteed for working pressure up to 10,000 psi. For complete details, request Bulletin No. NV-2.
T442 *Marsh Instrument Co.

Valves, Marine.....Steel valves listed in the Edward Marine Catalog conform to all requirements of U. S. Coast Guard regulations and various inspection, insurance and standards organizations. 32 p. Catalog 256.
432B Edward Valves.

Valves, Packless.....Packless valves are designed for tough applications, like critical high vacuums, corrosive or dangerous fluids and high temperatures. Company makes complete information available in a new Bulletin.
411 *Hoke Inc.

Valves, Plug.....OIC plug valves stay in adjustment a long time without leakage. Company makes specification literature available for those interested in the exclusive gland design and construction of these valves.
291 *Ohio Injector Co.

Valves, Plug.....For special services—handling products that will harden or congeal at ordinary temperatures—Wedgeplug Valves can be supplied steam-jacketed. Offers full details in Coated-Plug Folder.
315 *Wedgeplug Valve Co.

Valves, Porcelain.....Company makes available detailed literature covering the features and advantages of porcelain valves. Bulletin includes complete description, characteristics and specifications of product line.
173 *Lapp Insulator Co.

Valves, Reducing.....Announces new air loaded, diaphragm operated, pressure reducing valve for steam heat and process steam applications. Has simple design with only two moving parts. Bulletin 561.
432C Leslie Co.

Process Equipment

Centrifugals.....When your process calls for liquid-solids separation by centrifugal force . . . you can do it more economically with the new Tolhurst Center-Slung centrifugal. Request Bulletin TC-14-55.
356 *Tolhurst Centrifugals Div.

Centrifuges.....A Reineveld Centrifuge can reduce your Thermal Dryer requirements as much as 64% over conventional filtration methods. Capable of handling 1200 gallons per hour of feed slurry. Bulletin RC356.
135 *Heyl & Patterson.

Chlorinators.....V-notch chlorinators, built entirely with corrosion resistant materials, feature a new metering and controlling principle—the V-notch Variable-Orifice. See Publications 25,100 & 25.110.
432D Wallace & Tiernan.

*From advertisement, this issue

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FIG. 6061

Write for TABER BULLETINS C-355 for HORIZONTAL PUMPS ... for VERTICAL PUMPS V-837

Fig. 19,488

TABER PUMPS ARE specially built for handling chemical solutions, efficiently and economically . . . in the processing industries. The Vertical design permits locating stuffing box above and out of liquid level. Therefore nothing to leak.

BULLETINS as above gladly sent on request.

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Est. 1859
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TABER

LITERATURE . . .

Classifiers.....Sharples super classifier with ultra-sharp cutpoint at high capacity for classifying dry powders gives product recovery of 80% to well over 90%. For details on outstanding features, request Bulletin 1280.
125 *Sharples Corp.

Classifiers.....All classifiers (Rake Type, Spiral, Hydro) are designed to efficiently separate fine particles in specific applications. For complete information on company's line, request Bulletin C5C-B.
421c *Denver Equipment Co.

Collectors, Rectangular.....Bulletin covers flight collectors for rectangular settling basins. Includes design data, detailed descriptions, specifications, photographs and drawings. Request Bulletin No. 8W68.
433A Walker Process Equipment.

Concentrators.....Roto-vak concentrator features: increased capacity; lower operating cost; simplicity of operation; ease of cleaning; sterilization combined with concentration. For details, see Bulletin 369.
88 *Blaw-Knox Co.

Crushers, Jaw.....Cast steel frame, manganese jaw & cheek plates. Large diameter shafts reduce shaft deflection & thus increase life of heavy-duty oversize roller bearings in bumper. Bulletin No. C12-B12.
421d *Denver Equipment Co.

Cylinders, Gas.....Safety & long life are prime considerations in the design of Harrisburg high pressure gas cylinders. Yet they are as light as sound engineering permits. For details, request literature.
T447 *Harrisburg Steel Co.

Disks, Rupture.....Impervito Rupture Disks are standard for 150# flanges, temperature to 300° F., 5% accuracy, diameters from 2" to 12". A new idea in frangibles from Falls . . . expendable and economical. Literature.
423g *Falls Industries.

Disperser-Homogenizer..... Tri-Homo Pioneer model features: rotating trap basket at the feed; abrasion resisting wear rims; portable or fixed installations; discharges product at higher level. Details.
433B Tri-Homo Corp.

Dissolvers.....For processors of liquid-liquid, gas-liquid & solid-liquid products, including . . . chemicals, paints & inks, plastics, pharmaceuticals, foods & beverages. Many models to choose from. Request details.
163 *Morehouse-Cowles.

Dryers.....Brochure describes new "Surface" high speed, low-temperature dryers for continuous drying processes. Replace batch operation in production of chemicals, pigments, varnishes, etc. Bulletin K-156.
433C Surface Combustion Corp.

Dryers.....Lectro-dryers can dry air & gases in volume to dewpoints below —100°F.—can drop relative humidity lower than 10%. Booklet describes machines & how various industries use them to gain efficiency.
163 *Pittsburgh Lectrodryer Corp.

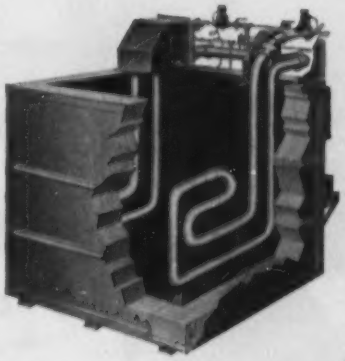
Dryers.....Available in several types: direct heat, indirect heat, and steam tube. Let Deco engineers help solve your drying problem—no dryer problem too small or too large. Details in Bulletin No. D4-B2.
421j *Denver Equipment Co.

Dryers, Rotary.....The Davenport rotary hot air dryer is of stainless steel construction. Dryer is installed in one of the large processing plants, drying wheat gluten. For complete details, request Catalog "A."
T458 *Davenport Mach. & Foundry.

Dust Collectors.....Describes company's line of dry centrifugal collectors . . . designed to handle large exhaust volumes containing dry, granular dust in large concentrations. Request Bulletin No. 291.
64 *American Air Filter Co.

*From advertisement, this issue

GET THE MOST HEAT TRANSFER



PER FUEL DOLLAR

Your fuel dollar buys more effective heat transfer with 'Surface' immersion heating than with other methods of heating liquids and salts.

Diffusion combustion and the heating tube immersed completely in the liquid put the heat where you want it, instead of out in the plant or up the stack. At the same time, gas firing gives you considerable savings over electricity at most temperatures.

A temperature range of 100°F to 1200°F is available in 'Surface' immersion heating. Tube design and materials can meet your specifications. Safeguards are readily applied to all 'Surface' immersion heating units.

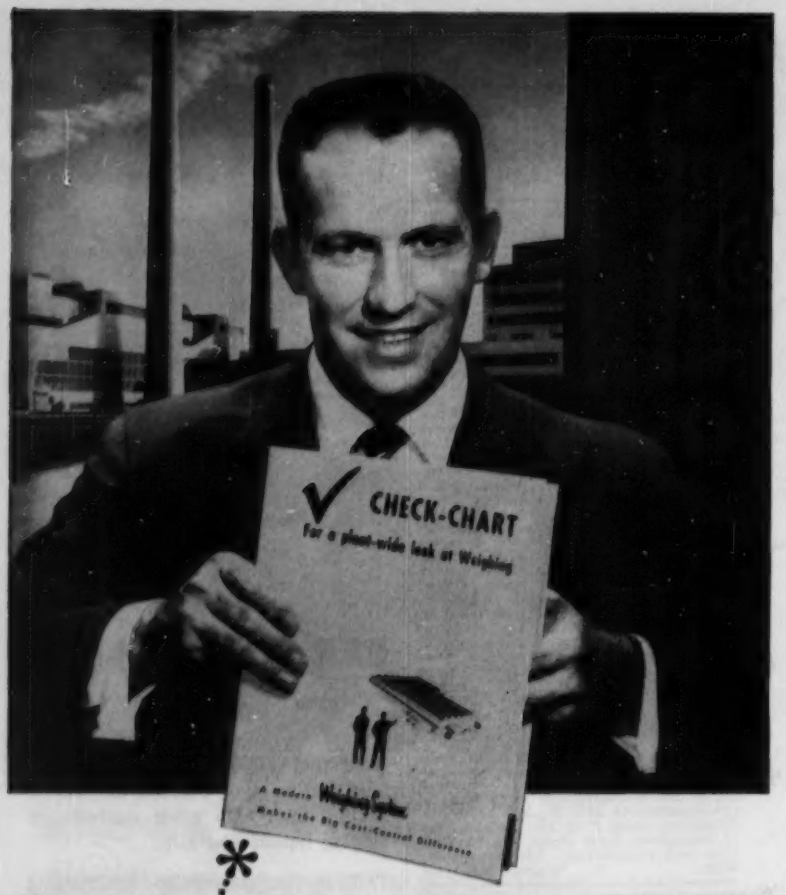
Write for Bulletin SC-156.

Surface Combustion Corporation, 2367 Dorr St., Toledo 1, Ohio

Surface
HEATING EQUIPMENT

SURFACE COMBUSTION

Also makers of Janitrol® automatic space heating and Kathabar® humidity conditioning



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Your scales are a vital element in effective cost and quality control. Errors in weighing go all the way through accounting and affect cost . . . profit . . . or loss! You need to look at *all* your weighing today . . . not as isolated scales, but as a *weighing system.*

Toledo's new Scale Check Chart will show you quickly and accurately how well your scales are serving you, and provide the information you need for truly effective cost control.

This new Check Chart is yours for the asking in a handy kit that contains all you need for an easy, informative appraisal of weighing in your plant. Send for it today. Address Toledo Scale Company, 1403 Telegraph Rd., Toledo 1, Ohio.

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LITERATURE . . .

Dust Collectors.....Maximum filtering efficiency, bag cleaned uniformly and automatically, overcleaning eliminated to prolong bag life, easy to assemble in less space. For further details, request Aeroturn Booklet.
393 *Koppers Co.

Dust Collectors.....In almost every type of industry . . . users have found high efficiency, simplicity & economy of Dustube collectors a difficult combination to equal for top performance. Request Bulletin No. 372.
314 *Wheelabrator Corp.

Dust Collectors.....New self-cleaning collector offers continuous automatic operation, constant air volume and suction, uniform air flow resistance at low cost. For complete details, request Bulletin No. 916.
383 *Pangborn Corp.

Filter Cloth, Metallic.....Newark metallic filter cloth is available in a variety of weaves in all malleable metals, and is adaptable to practically all types of filters. Complete data in new Catalog "E."
412 *Newark Wire Cloth Co.

Filter Paper.....The use of E&D filter paper as a cover may be indicated if your filter medium is blinding or clogging. Will recommend proper grade for use and send samples for testing. "Filtration Analysis Report."
B442 *Eaton-Dikeman Co.

Filters.....Bulletin describes Flo-Klean filters for raw water, light process liquids, and centralized coolant systems. Continuously and automatically self cleaning. Request revised 12 p. Bulletin No. 052.
434A Cuno Engrg. Corp.

Filters.....Bulletin describes the distinguishing characteristics, construction, sizes, operation and advantages of widely applied cane sugar filter. Designed for high efficiency cane mud washing. Bulletin 4093.
434B Derr-Oliver.

Filters.....New built-to-order vertical filters solve complex problems & are easily adapted for special uses. For details on flow systems, special equipment, filter & leaf construction, request Bulletin No. 111.
365 *Industrial Filter & Pump.

Filters, Air.....New dry type air filters for automotive and industrial applications. Booklet will guide you in making the proper selection for your own specific problem. For information, see Catalog AFC-56.
434C Purolator Products.

Filters, Disc.....Special, patented design of segments in filters use both gravity & vacuum to give a drier filter cake. Drainage is complete & positive with no blow-back. Details contained in Bulletin F9-B2.
431f *Denver Equipment Co.

Filters, Horizontal Plate.....New "Batch-Miser" horizontal plate filter recovers 100% of both liquid and solids—without scavenging. There is no leakage, no warping of plates. Request descriptive Bulletin.
357 *Niagara Filter Div.

Filters, Industrial.....The IWF industrial filter features: efficient high flow backwash design; choice of 5 basic sizes; high-polish, diatomite filtration; batch or fully continuous "on-stream" operation. Bulletin 651.
434D R. P. Adams Co.

*From advertisement, this issue

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DO IT YOURSELF !!

MAKE YOUR OWN PUMP SEAL SELECTIONS!!

THE NEW SEALOL FLEXIBOX SEALECTOR ENABLES YOU TO DECIDE ON SEAL TYPE SIZE AND MATERIALS FOR YOUR SPECIFIC REQUIREMENTS. THE SEALECTOR COVERS 48 TYPICAL PRODUCTS BEING HANDLED IN THE PROCESS INDUSTRIES.

HERE'S HOW IT WORKS—

Typical Example — Butane @ 250 PSIG, 160°F — Shaft Size 1⅝"

1. FRONT

PROCEDURE — STEP I — *AUTOMATIC SELECTION OF SEAL TYPE AND MATERIAL — SET POINTER ON PRODUCT:*

TYPE —

RRCB FLEXIBOX

RR = BALANCED DESIGN

C = CIRCULATED PRODUCT

B = THROTTLE BUSHING

MATERIAL —

STATIONARY SEAL RING — CARBON

ROTARY SEAL RING — TYPE 347 STAINLESS STEEL

ROTARY SEAL RING FACE — STELLITE

SPRING — TYPE 18-8 STAINLESS STEEL

GLAND PLATE — STEEL, PLATED

O RINGS — BUNA BASE RUBBER

2. BACK

STEP II — *DETERMINE SEAL SIZE FROM SHAFT DIMENSION:*

TYPE = RRCB

SHAFT = 1.625"

MIN. STUFFING BOX BORE = 2.625"

MIN. BOX DEPTH = 2.625"

SEAL SIZE = 40

SEND FOR YOUR SEALOL FLEXIBOX SEALECTOR ON YOUR LETTERHEAD TODAY — AT NO CHARGE.

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SEALOL

THE BALANCED PRESSURE SEAL

LITERATURE . . .

Filters, Vacuum, Rotary, Continuous.....The Original String Discharge Filter is only one of many types of FEInc continuous rotary vacuum filters available . . . custom-made at standard costs. Request Bulletins.
169 *Filtration Engineers.

Fume Systems, Plastic.....Haveg fume removal units are light in weight for easy, low cost installation, or for heavy duty service where required. Haveg is tough, durable, machineable, easily repaired. Bulletin F-7.
391b *Haveg Industries.

Generators & Dryers.....Pipe line purging problems solved by Kemp gas generator & dryer. As a unit they insure a constant supply of gas, & dry & free the gas sufficiently of oil vapors. Request information.
67 *C. M. Kemp Mfg. Co.

Generators, Gas.....Compact unit produces protective atmospheres from natural gas or commercial propanes for processing and packaging. Provides constant, oxygen-free atmosphere. Request complete specifications.
417b *W. F. & John Barnes Co.

Generators, Turbine.....Releases new bulletin on turbine generators covering the 1500 to 15000 KW range. Includes information on types and applications, turbine and generator construction, etc. Bulletin 1960C-P.
435A Worthington Corp.

Grinding Machines.....Sturtevant Micronizer grinding machines give greater finenesses than tube or roller mills. Feature: no moving parts; instant accessibility; easy cleaning. For details, see Micronizer Bulletin.
161 *Sturtevant Mill Co.

High Pressure Apparatus.....Hofer's Catalog covers their manufacturing program; high pressure apparatus—general instructions, technical explanations, autoclaves; apparatus for semi-technical plants.
435B Chemtech Prods. Corp.

Homogenizer-Mixers.....High speed, high shear homogenizer-mixer for "novortex" mixing of chemicals and pharmaceuticals to produce emulsions of small particle size and long shelf life. Catalog 402R-2.
385 *Gifford-Wood Co.

Kilns, Rotary.....Efficient thermo-processing of products. Used in the production of lime, bauxite, cement, sodium silicate, alumina, etc. Complete data on design features offered in illustrated Bulletin 1115.
305 *Traylor Engrg. & Mfg. Co.

Lubrication Systems.....The air-operated transfer pump cuts costs in your plant . . . transfers 37 lbs of pressure gun grease per minute while sealing the lubricant at all times. See "5 Plans for Better Lubrication."
73 *Stewart-Warner.

Mills, Ball.....A steel-head ball mill will suit your particular need. Five types of discharge trunnions. All-steel construction. Low initial cost due to quantity production. Quick delivery. Bulletin No. B2-B13.
421b *Denver Equipment Co.

Mills, Bowl.....Raymond Bowl Mill . . . complete, full coordinated coal pulverizing system with flexible control and automatic operation . . . will modernize your rotary kiln firing. Request Catalog No. 75.
352 *Raymond Div.

Mills, Roller.....Positive and continuous precision size control at exceptionally high production rates are but two of the numerous features of Williams Roller Mills. Request fully descriptive new Catalog.
171 *Williams Patent Crusher.

Mixers.....Mix-Mullers for chemical and process industries. Covers Simpson mulling principle; mulling for dry, wetted and plastic mixtures; special requirements; etc. "Mulling for the Chemical & Process Industries."
85 *National Engrg. Co.

*From advertisement, this issue

Strahman

RAM TYPE Drain Valves

The Only Drain Valve That Cannot Clog Up!

In the closed position the piston or ram extends up into the tank, preventing plugging of the outlet.

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Made in any cast metal to meet your requirements.

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OXYGEN

key to modern industrial processes

Control it with...

Arnold O. Beckman INC.

OXYGEN ANALYZERS!

Oxygen is one of the most important factors found in modern chemical and industrial processes. Whether to minimize product oxidation (prepared atmospheres, air infiltration, etc.) ... or to insure adequate oxygen for efficient combustion (boilers, kilns, etc.) ... or to control oxygen for proper process operations (ammonia, acetylene, air fractionation, etc.) oxygen control has become too important in today's operations for any profit-minded executive to overlook.

And because they are the *only* instruments that measure oxygen content directly, accurately and conveniently, Arnold O. Beckman Oxygen Analyzers have become the leading instruments for modern oxygen control in a wide range of applications—from catalytic refineries to cement kilns—from power plants to personnel protection.

These instruments (and systems) can be built to meet *your individual* needs.

These instruments offer many unique advantages...

SELECTIVITY: Highly sensitive to oxygen. Effects of gases other than oxygen are negligible.

HIGH ACCURACY: 1% of full scale (Example: ±0.05% O_2 on range 0-5% O_2).

MANY RANGES: Full scale ranges from 0-1000 ppm or up to 0-100% O_2 available. Combustion ranges 0-5, 0-10, 0-15% O_2 supplied with 0-25% O_2 check range. Multi-range instruments available.

RAPID RESPONSE: Standard Analyzers—95% response in less than 1 minute. Special Units—95% response in 7 seconds!

USE ANY RECORDER: Millivolt output for potentiometers; current output for miniature electronic recorders and galvonometers; air output for pneumatic receivers and control systems.

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SAMPLING SYSTEMS: Complete standard systems—components, package or portable units are available.

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Model 62: Full scale ranges 0-0.1%, 0-0.5%, and others for low O_2 content. Ranges 90-100%, 95-100% O_2 for high O_2 content.

The above are but two of the complete line of Arnold O. Beckman Oxygen Analyzers available for every requirement.

Send for helpful free literature which describes Arnold O. Beckman instruments in detail. When writing, outline your particular application—we'll gladly supply specific information.

Ask for Data File 20X-86

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ANALYZERS

Profit Builders for Industry

1020 Mission Street

South Pasadena, California

See these instruments at the ISA Exhibit, Sept. 17-21, also at Iron & Steel Exhibit, Sept. 26-29

LITERATURE . . :

Mixers.....Company makes available Confidential Mixing Data Sheet. Helpful checklist enables you to develop a complete technical description of agitation required for your process, quickly & easily. No. B-107.
227h *Mixing Equipment Co.

Mixers.....Describes Super Agitators & Mixers. Patented standpipe around propeller shaft assures positive agitation & circulation. Patented wearing plate prevents sand-up on shut-down. Bulletin No. A2-B4.
421a *Denver Equipment Co.

Mixers, Pony.....The exceptionally rugged, heavy duty design characteristics of the Day pony mixers enables you to mix a stiffer, heavier paste, resulting in many advantages. Details in Bulletin No. 500.
363 *J. H. Day Co.

Mixers, Portable.....Use in industry reduces costs, saves time, labor and secures better and more refined products. Catalog includes data on construction, dimensions, specifications, etc. 28 p. Bulletin B-108.
227e *Mixing Equipment Co.

Mixers, Portable.....Portable mixer mounting assemble allows effortless adjustment up and down and right or left to any angle for the mixing action your process might require. For details, request Mixer Catalog.
379 *Alsop Engrg. Corp.

Mixers, Side Entering.....Furnishes detailed information on features, typical applications, mechanical design, maintenance, shaft seals, methods of installation, etc., in completely illustrated Catalog B-104.
227d *Mixing Equipment Co.

Mixers, Top Entering.....Illustrated and detailed 32 p. Catalog includes advantages, typical installations, mechanical description, construction information, dimensions and selection tables, etc. Catalog No. B-102.
227a *Mixing Equipment Co.

Mixers, Top Entering.....Makes available pertinent information on top-entering mixers (propeller type) . . . for closed tanks, pressure & vacuum . . . for open & loose-covered tanks. Data in Catalog No. B-103.
227b *Mixing Equipment Co.

Mufflers, Air Exhaust.....Introduces "Atomuffler" model engineered for better noise cancellation and easier installation. Features new 4-port deflector. Company makes literature available on request.
436A Allied Witan Co.

Process Equipment.....Sprout-Waldron installations achieve a degree of specific fitness that is unusual in industry. Offers bulletin on equipment & systems for processing dry & semi-dry materials. Bulletin 95.
153 *Sprout-Waldron.

Process Equipment, Fabricated.....For your most efficient means to fast, economical production, for individualized equipment designed & constructed to fit your needs, request a copy of Koven's Bulletin 550.
285 *L. O. Koven & Bro.

Processing Equipment, Dry.....Unique "open-door" feature means the vital parts of any unit are accessible by "one man in one minute" . . . cleaning, inspection and maintenance are accomplished easily. See Catalog.
436B Sturtevant Mill Co.

*From advertisement, this issue

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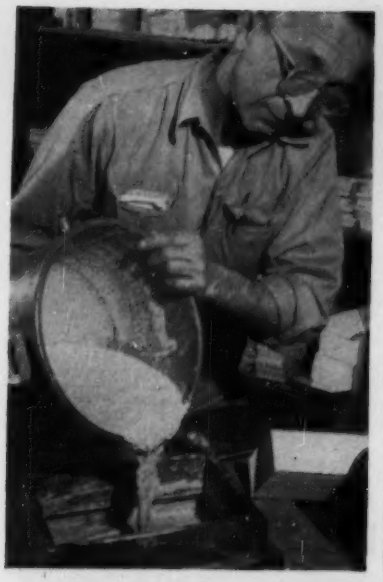

New ALUNDUM* 33-I Insulating Castable

Mixes and pours like concrete . . . protects up to 3300°F.

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For full particulars, see your Norton Refractories Engineer. Or write to NORTON COMPANY, 507 New Bond Street, Worcester 6, Massachusetts.

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LITERATURE . . .

Processing Equipment.....Describes corrosion-resistant processing equipment . . . precision built to your specific requirements to give long years of peak performance with low maintenance. Technical Bulletins.
377 *Lee Metal Products Co.

Pulverizers.....Valuable data on Superfine pulverizer . . . a centrifugal air attrition impact pulverizer and classifier in a single unit. Covers numerous features, specifications, construction, etc. Illustrated.
B444 *Schutz-O'Neill Co.

Reactors, Glassed Steel.....Offer a wide range of sizes . . . 5 to 4,000 gals.; several ways to adapt top-head openings, agitators, seals, and valves in meeting changing temperature and pressure requirements. Bul. 936.
454 *Pfaudler Co.

Reactors, Research.....For complete information on new General Electric 7-point program and research reactors: swimming pool reactor; heavy water research reactor; nuclear test reactor, request Bulletin GEA-6326.
52-3 *General Elec. Co.

Screens, Gyratory.....New in design, performance & economy. Top efficiency in screening . . . maximum capacity . . . profit insuring quality control . . . simplified maintenance, etc. For details, see Bulletin 17B8446.
299 *Allis-Chalmers.

Screens, Vibrating.....For high-capacity screening of a broad range of materials—"CA" vibrating screens are your answer. In complete range of sizes to suit all plant capacity requirements. New Book 2554.
164a *Link-Belt Co.

Screens, Vibrating.....For economical separation of light to medium weight materials—choose "UP" vibrating screens. In open, semi-enclosed, or totally-enclosed types. Complete details contained in Book 2377.
164b *Link-Belt Co.

Separators, Entrainment.....For complete liquid-vapor separation use Metex Mist Eliminators . . . in vertical tube evaporators, packed columns, distillation columns. For complete details, request Bulletin ME-6.
409 *Metal Textile Corp.

Separators, Industrial.....New bulletin explains basic separation principles in graphic detail, and presents a comprehensive listing of centrifugal separator applications. Request your copy of Bulletin 2173.
437A Centrico Inc.

Shakers, Reciprocating.....The Reciprocating Shaker comes in two models . . . Models R-7, R-8 . . . both offering modern design, rugged construction, precision built, quiet operation, etc. See Circular.
437B New Brunswick Scientific Co.

Tables, Concentration.....Separate materials into bands & handle coarsest sands with excellent results. Ideal for separation of groups of particles having similar range of specific gravities. Bulletin TI-B3.
421h *Denver Equipment Co.

Trays, Turbogrid.....Special construction of new Turbogrid tray has made all of the processing advantages of corrosion resistant glassed steel available for use in tray type columns. Further information is available.
437C Pfaudler Co.

Vessels, Pressure.....Developed by specialists producing pressure vessels, vacuum tanks, towers, reactors, weldments and sub-assemblies. Request this easy-to-read, illustrated booklet, "Facilities and Products."
168 *Newport News Shipbuilding.

Washers, Air.....Air washing provides a higher degree of cleaning than simple filtering. It also cools and humidifies. For complete information on "Buffalo" Air Washers, request Bulletin 3142-E.
66e *Buffalo Forge Co.

*From advertisement, this issue

SCRUBBING CORROSIVE GASES?

Are you scrubbing nozzles as efficiently as you think they could be? Do they resist the corrosion or wear conditions satisfactorily —produce the breakup and distribution you would like?

Outline your spray problem for us—if your liquid can be sprayed with direct pressure at all—Monarch can furnish the nozzles

NOZZLES FOR:

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- AIR WASHING
- DESUPERHEATING
- SPRAY PONDS
- MILK POWDERING
- ACID CHAMBERS
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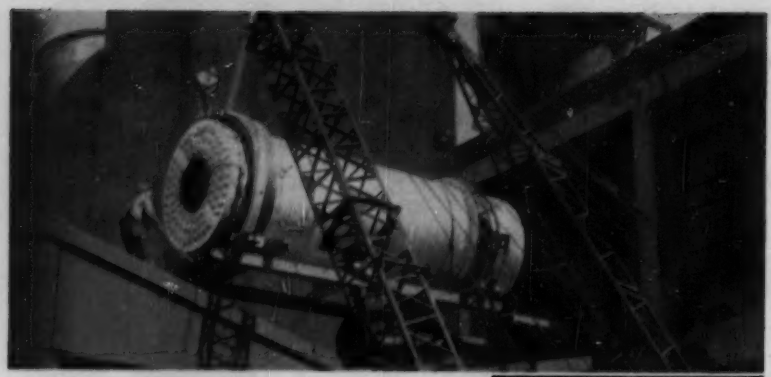

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"Davenport" Rotary Steam Tube Bean Conditioner 7′ x 21′

Built specially to fit available space on the third floor of a large soybean solvent extraction plant in central Indiana.

Let our engineers consult with you on your Pressing, Drying, and Cooling problems. Send for complete Catalog "A" or for quick reference, consult your CHEMICAL ENGINEERING CATALOG, 1954, 1955, or 1956.

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LITERATURE . . .

Wire Cloth.....80 p. catalog describes company's facilities for fabricating wire cloth parts. Includes wire cloth parts for screening, filtering and special uses. Also provides helpful metallurgical information.
382 *Cambridge Wire Cloth Co.

Pumps, Blowers, Compressors

Compressors.....Joy WGV-9 Compressor . . . vertical construction eliminates uneven cylinder wear and reduces installation cost . . . lightweight truncated aluminum piston contributes to low power consumption. Bul. 103-11.
8 *Joy Mfg. Co.

Compressors.....Describes Allis-Chalmers single and two-stage vane type compressors for shop air, gas handling, drilling and numerous other applications. Request Bulletin Nos. 16B8244 and 16B8126.
159 *Allis-Chalmers Mfg. Co.

Compressors.....The Type FMP reciprocating compressor is built for field pick-up service, gas boosting, air drilling and general industrial use. Company makes further details available in Bulletin No. F-80.
438A Cooper-Bessemer Corp.

Compressors.....Every Norwalk compressor is test-run for 8 hours, then taken down for complete inspection before re-assembly and shipment. Complete catalog describes compressors from single stage to six stages.
428 *Norwalk Co.

Compressors, Air.....Bulletin on integral motor air compressors gives mechanical advantages, standard accessories, special accessories, performance tables and application ideas. Bulletin P-356 is available.
438B Gast Mfg. Corp.

Compressors, Centrifugal.....De Laval compressors are designed and built for heavy duty continuous operation. Rugged, horizontally split casings . . . individually designed impellers . . . etc. See Bulletin 0504.
160 *De Laval Steam Turbine Co.

Compressors, Rotary.....Fuller applies each compressor to a specific job, with resultant overall plant economy, as well as power savings. Company makes details on Fuller rotary compressors available in Bulletin C-5A.
332 *Fuller Co.

Exhausters.....Company makes available new standard and heavy-duty commercial power exhausters, developed for handling industrial venting applications and commercial heating plants. Request details and engineering data.
438C Quickdraft Co.

Fans.....“Buffalo” Type BL Limit-Load Ventilating Fans, Axial Flow Fans & Heavy Duty Propeller Fans are creating favorable air conditions in many plants. See Bulletins F-100, 3533-EF & FM-1224.
66a *Buffalo Forge Co.

Fans, Rubber - Lined Clarage's heavy-duty construction, plus the added advantage of special coatings, add up to far longer service life. Exhausting corrosive fumes are no problem for these fans. Bulletin 702-A.
38 *Clarage Fan Co.

*From advertisement, this issue

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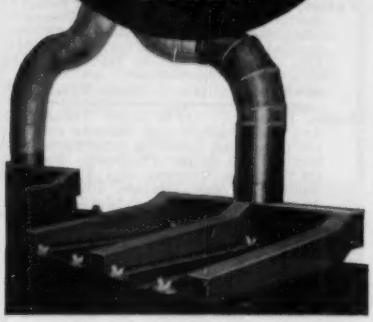
Simply circle the code numbers desired on the handy pre-paid postcard, and mail it to us. Replies will reach you direct from the companies manufacturing the products.

AGILE'S Plastic Ductwork Costs Less...Has Longer Service Life Than Stainless Steel



AGILE'S Plastic Installation

- **Cost** **$491.00**
- **Service....Still in use after 5 years**

Stainless Steel Installation

- **Cost** **$581.00**
- **Service....only 16 months**

PROBLEM: This company was using a type 19-9 stainless steel stack for venting the fumes on a sulphuric acid tank. This stack was installed at an original cost of $581, was no longer serviceable after 16 months because of corrosion.

SOLUTION: The company replaced the stainless steel installation with a plastic structure of equal dimensions for $491.00. The new stack still in perfect condition, has a life expectancy of many, many years.

Whenever you have a corrosion problem, check with American Agile. Many years of research and wide practical experience have made American Agile experts in the fields of plastics and corrosion prevention.

For detailed information be certain to write for your free brochure . AA-4

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Plant and General Office

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LITERATURE . . .

Intensifiers & Pumps, High Pressure.....Bulletin covers Harwood laboratory and industrial high pressure intensifiers and pumps . . . 5000 to 350,000 psi. Includes various models with specifications.
439A Harwood Engrg. Co.

Pumps.....Ingersoll-Rand motorpumps have well-balanced impellers and precision machined parts help provide peak performance and smooth operation on every job. Request the latest Motorpump Catalog for details.
387 *Ingersoll-Rand.

Pumps.....Taber pumps are built for handling chemical solutions, efficiently & economically . . . in the processing industries. Details on horizontal pumps in Bulletin C-355, & for vertical pumps request Bulletin V-837.
L433 *Taber Pump Co.

Pumps, Acid.....80-gpm. centrifugal pump with hard rubber casing and impeller, Hastelloy C shaft. Handles nearly all corrosives. Mechanically simple, trouble-free. For information, request Bulletin CE-55.
375b *American Hard Rubber Co.

Pumps, Acid.....On most difficult pumping jobs . . . dependable highly efficient pumps deliver continuous, trouble-free performance on round-the-clock schedules wherever they are installed. Full details.
367 *A. R. Wilfley & Sons.

Pumps, Acid & Chemical.....Pumps to handle every acid or chemical fluid used in industry. Offers help with particularly difficult chemical pumping problems. For pertinent details, request Bulletin 203-7.
376 *Lawrence Pumps.

Pumps, Centrifugal.....The Series E Chempump is a low-cost, compact canned motor pump less than 5 inches long. Details on performance, materials of construction, and dimensions are in Bulletin 1000.
439B Chempump Corp.

Pumps, Centrifugal.....New Gardner-Denver BL Pumps stay efficient even when volume on head fluctuates. Designed to deliver peak performance over broader ranges of service conditions. Request Bulletin No. A-8.
318 *Gardner-Denver Co.

Pumps, Centrifugal.....From impeller to shaft seal . . . Weinman pumps are built better. The built-in quality adds up to cost-saving, pumping efficiency for every job. Request descriptive product Bulletin.
371 *Weinman Pump Mfg. Co.

Pumps, Centrifugal.....Standard, single stage, end suction, centrifugal process pumps . . . Series 10, 20 and 30 . . . for industrial, refinery and general service are described in a new, illustrated Circular No. 184.
368 *Dean Bros. Pumps.

Pumps, Centrifugal.....Complete line of class CRV cradle-mounted centrifugal pumps . . . capacities from 5 to 2800 gallons per minute . . . pressures of 10 to 525 feet total head. For information, Form 7222-B.
439C Ingersoll-Rand.

Pumps, Centrifugal.....Standard Impervite pump models are furnished up to 200 gpm, 100 ft. head, and specials are available in the range of 1000 gpm. Company makes further information available on request.
423f *Falls Industries.

Pumps, Centrifugal.....Monobloc centrifugal pumps are designed to offer a wide range of sizes to fit every pumping system. Feature oversize ball bearings for long trouble-free life. See Bulletin W-206-B3D.
439D Worthington Corp.

Pumps, Chemical.....Furnishes a complete line of Buffalo pumps, ready to handle corrosive or abrasive liquids at least maintenance cost. For full product information, request illustrated Bulletin 982.
360 *Buffalo Pumps.

*From advertisement, this issue

Why You Should Specify..

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Dependability
accepted by Leading National Manufacturers

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motors 1/20 H.P. to 2500 H.P. Generators ½ K.W. to 2000 K.W.
Built to Your Specifications

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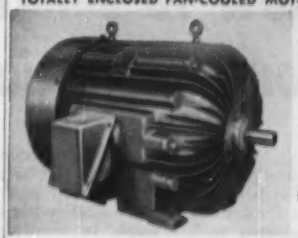
General Purpose: 1/20 HP-up From Stock
Special Purpose: Built to YOUR Specifications

FRACTIONAL H.P. MOTORS

NEW NEMA INTEGRAL HP MOTORS

Provides 4 in 1 Protection: Drip-proof ...Splash-proof Weather Protected ...Guarded
All at Open Motor Prices

TOTALLY ENCLOSED FAN-COOLED MOTORS



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Explosion Proof Ratings to 250 HP
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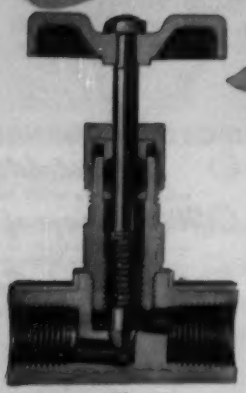
Automator-Adjustable Speed Drives

MARATHON ME ELECTRIC

HOME OFFICE AND FACTORY, WAUSAU, WIS.
FACTORIES AT ERIE, PA. AND EARLVILLE, ILL.

Now... the Marsh Needle Valve in 416 Stainless Steel throughout!



All the superior dependability of the Marsh Needle Valve... with all the corrosion resistance and durability of 416 Stainless Steel! Guaranteed for working pressure up to 10,000 psi; equally efficient at any lower pressure. Globe and angle patterns with double female connections in ¼" to 1" size range. Also globe and angle valves with male inlet, female outlet, ¼" and ½" sizes.

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E&D

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You can rely on the experience of the *only* company in America *exclusively* engaged in the manufacture of filter papers for science and industry.

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FILTERTOWN
MT. HOLLY SPRINGS, PENNA.

LITERATURE . . .

Pumps, Direct Flow.....Data Sheet illustrates & describes the Aldrich 6" Stroke Direct Flow Pump Series. Includes Triplex, Quintuplex, Septuplex & Nonduplex Pumps, ranging in power from 300 to 900 hp. Data Sheet 67A.
362 *Aldrich Pump Co.

Pumps, Metering.....Booklet includes specifications, chemicals most commonly used in water conditioning, what they are used for, and the pump construction best suited to inject them. Request Booklet No. 600.
440A Hills-McCanna Co.

Pumps, Vacuum.....Bulletin on integral motor vacuum pumps gives mechanical advantages, standard accessories, special accessories, performance tables and application ideas. Bulletin V-356 is available on request.
440B Gast Mfg. Corp.

Vents, Tank.....OPW Tank Vents trap and hold vapors and release only at set pressures, insuring maximum protection and dollar dividends. See the OPW Tank Venting and Emergency Relief Recommendation Chart.
18 *Jordan Corp.

Services, Processes, Misc.

Apparel, Industrial.....Chem-Wear introduces completely new, competitively-priced line of industrial workclothing. Combines 68% Dynel with 32% cotton to produce light, tough garment. Request literature.
440C Chem-Wear.

Cleaning, Chemical.....Series of 7 folders cover the intangibles behind the chemical cleaning service Dowell offers. Designed to present a broad picture of company's operations. Folders available on request.
440D Dowell Inc.

Demineralization.....Covers all phases of demineralizing . . . discusses in detail the advantages and disadvantages of this process for today's power plants . . . considers trends and applications. Reprint T-140.
440E Graver Water Conditioning.

Design & Fabrication.....“Collection and Correlation of High Temperature Hydrogen Sulfide Corrosion Data” is a typical example of Kellogg's “built-in engineer” approach to process equipment design and fabrication.
167 *M. W. Kellogg Co.

Design & Manufacture.....Booklet gives a factual presentation of company's ability to design and manufacture a wide variety of heavy machinery and machine tools. Request 44 p. booklet, “This is Farrel-Birmingham.”
440F Farrel-Birmingham Co.

Engineering Services.....Help protect your equipment investment—application engineering, analytical engineering, product development, field-service engineering, maintenance service, etc. Bulletin GED-2244.
40-1 *General Elec. Co.

*From advertisement, this issue

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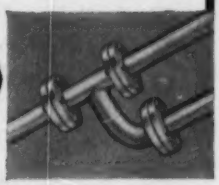
HERE'S HOW...

Speedline tangential feature (extra straight section) gives you assembly advantages. You can flange where you want to, weld where you want to. Speedline fittings are adaptable to your job requirements.

Speedline tangential feature allows ample clearance for direct flanging or butt welding.



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Bulletin 355

This 52-page BOOK

proves that old-style pipe coils are too costly, too large, too heavy, too slow, too inconvenient, and too inefficient. It makes clear why the

DEAN THERMO-PANEL COIL

is now being specified by discriminating chemists and engineers. See, for instance, the OUTSIDE HEATED drum at the right. The book is full of actual examples of heating and cooling.

ASK FOR

Bulletin 355. If you want to do your own designing and estimating ask for Bulletin 256. Also, Dean engineers will gladly help.

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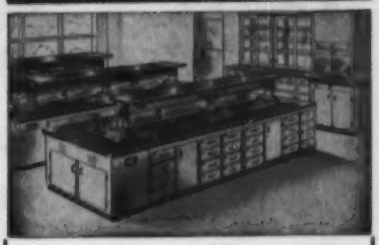

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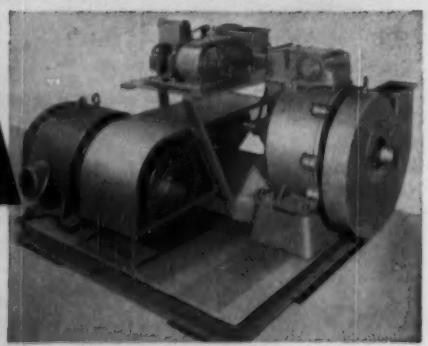

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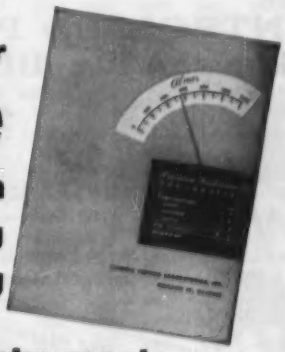

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